



## What is Knowledge as an Actual-World Phenomenon?

Joke H. van Velzen

Research Institute of Child Development and Education, University of Amsterdam,  
The Netherlands

### Abstract

What is knowledge? Cognitive, social, and educational psychologists define it as a collection of information or facts and their meaning in relation to each other that is stored in the brain, but in each of these psychological areas, a different facet is highlighted. Cognitive psychologists study knowledge as the construction and representation of information in memory. Social psychologists study knowledge as the influence of feelings, beliefs, and attitudes on behavior. Educational psychologists study knowledge as the improvement of performance through training, instruction, and teaching. Currently, encouraged by the replication crisis and the epistemic philosophical views, more psychological researchers are beginning to shift their focus towards knowledge as an actual-world phenomenon, which especially has much ground in common with the discipline of cognitive science (i.e., artificial intelligence and the neurosciences). However, this anew direction in the psychological study of knowledge is complicated, in that researchers have to reckon with its dynamical nature in the actual world. The dynamical character of knowledge involves that it (a) changes over time in various manners, (b) is an experientially personalized construction, and (c) is capriciously interacting with situational influences. The difficulty in scientifically observing knowledge as an actual-world phenomenon encompasses (a) how individuals retrieve knowledge via cognitive, social, and emotional considerations, (b) how knowledge has an interaction with the individual's physique and behavioral expression modes, and (c) how knowledge has an interaction with the present situation or surrounding environment. In this article, I will discuss present theories, views, and scientific evidence and findings in psychology, philosophy, and cognitive science regarding knowledge as an actual-world phenomenon with the aim to provide for methodological suggestions for future psychological research.

### Theories of Knowledge: A Preliminary Description

What is knowledge? Broadly defined, the psychological construct of knowledge refers to the collection of information that is stored in the human brain, in that it can be retrieved, supplemented, and reorganized, and that is essential for executing mental functions (i.e., attention, memorizing, and thinking), performing social behavior (i.e., interacting with other human beings), and solving tasks and problems (i.e., life-, social-, and work-related). This broad definition of knowledge encapsulates the three main psychological areas of cognitive, social, and educational psychology, respectively, each containing a variety of psychological domains (e.g., memory, self-concept, and training) and theories. Although it is undoable to discuss justifiably the current scientific findings in these areas in this article, below some examples are presented to illustrate the variety of theories that exist in a domain. The first example describes the main theories in cognitive psychology regarding the domain of memory (see Anderson, 2015; Camina & Güell, 2017; Goldstein, 2018; Nolen-Hoeksema et al., 2020, for overviews). Memory is defined as information storage in the brain, and it encompasses kinds of (a) stores, such as sensory, short-term, and long-term memory of which short-term memory includes a working system or working memory, (b)

information, such as episodic, declarative, and autobiographic, (c) memories, such as explicit-implicit, flashbulb, false, and (in-) stable, (d) processing, such as encoding, learning, and forgetting, (e) organizing, such as schemas and cognitive maps, and (f) influences, such as attention, stress and cognitive load. These theories on memory can describe information storage in the brain, although it is yet unknown when which piece of information will be retrieved.

The second example describes the main theories in social psychology regarding the domain of the self in the social context (see Baumeister & Bushman, 2021; Stangor et al., 2022, for overviews), which is defined as the influence of the social situation on the self-concept, and which encompasses kinds of influences (i.e., mostly positive, neutral, and negative) regarding (a) how others view us, such as the looking-glass self, self- and other-labeling, and social-cultural grouping, (b) how we compare ourselves with others, which can determine our evaluations of events and self-esteem, and (c) how our identity can change as a function of situations, such as self-presentation dependence on the audience and long-term reputation management. These theories reveal the many kinds of influences on the self-concept in the social context, although it is difficult to predict the extent of these influences on someone's actual social behavior.

The third example describes the main theories in educational psychology regarding the domain of the training of executive functions (see Andrés et al., 2021; Bialystok, 2017; Diamond & Ling, 2020; Goldstein & Naglieri, 2014, for overviews). Executive functions are defined as the cognitive control processes involved in balancing the mental resources in information processing (i.e., inhibitory control, working memory, and cognitive flexibility), and which encompasses (a) the explicit training of inhibitory control and cognitive flexibility, such as explicitly practicing social and emotional understanding in younger children and academic excellence in students, (b) stress reducing physical activities that also require body-mind coordination, such as sedentary mindfulness training, although this can vary per executive function, and (c) complex-span tasks (i.e., improving counting-, reading-, and operations-span), especially when they are practiced alongside reading, writing, calculating, and reasoning. The theories on executive functioning show that individuals primarily improve on *what* they practice rather than obtaining general cognitive fluency, which makes executive functioning experience and content dependent (Choo et al., 2021). Furthermore, individuals obtain different results depending on their age group (i.e., children, adolescents, adults, and elderly adults) and the intensity of the training. Therefore, the theories on training executive functions remain indecisive of what someone will train.

These three examples were presented to illustrate the variety of psychological theories in a domain regarding the subject of knowledge, and they are all obtained via scientific theorizing and the collecting of evidence and findings. Although it is not common in the scientific literature to distinguish between constructs and concepts, they certainly refer to something different (Markus, 2008). In the three examples, knowledge is a construct because it is made or formed by combining parts (i.e., theories, evidence, and findings) by extending over actual cases to obtain an understanding of the specific parts and the specific relationships between the parts. In this way, research can advance our understanding about the characteristics of knowledge. However, because the evidence and findings suggest that to a certain degree these theories all present some true aspect of knowledge as humans are capable of getting access (explicit and implicit) to information stored in their brain, it

can be questioned if it is possible to obtain an overall psychological understanding of what knowledge is because there is so much possible variation in the appearances of knowledge that it complicates the making of predictions.

Hence, the question still stands: What is knowledge? Perhaps, describing knowledge as it is studied by other scientific disciplines than psychology can provide for some clarifications. For example, epistemic philosophers study the nature of knowledge via logical argumentation<sup>1</sup> and they have done so by especially focusing on what is scientific and psychological knowledge (see Lehrer, 1990; McCain, 2016, for overviews). Overall, epistemic philosophers define knowledge as propositional knowledge or knowledge of facts. This definition of knowledge entails that the representations of knowledge (i.e., the way we view information in our mind) are beliefs. In other words, when humans are in the state of knowing, then they are believing or accepting that it is knowledge, in that it is seen as true and justified information. The basis of knowledge consists of believing *that* rather than believing *in* or trusting, in that certain information is acceptable (i.e., having truth and justification) and, hence, only the individual beliefs are a mental state in its own right. Most epistemic philosophers agree that the nature of one's knowledge consists of accepting that it is knowledge. This is similar to psychological researchers, who also differentiate between knowledge and beliefs or judgments about knowing (Nelson, 1996). Dissimilar to psychological researchers, epistemic philosophers view knowledge as a concept or something that is conceived in the mind as an abstract idea or notion, in that concepts extend not only over actual, but also over possible cases (Markus, 2008).

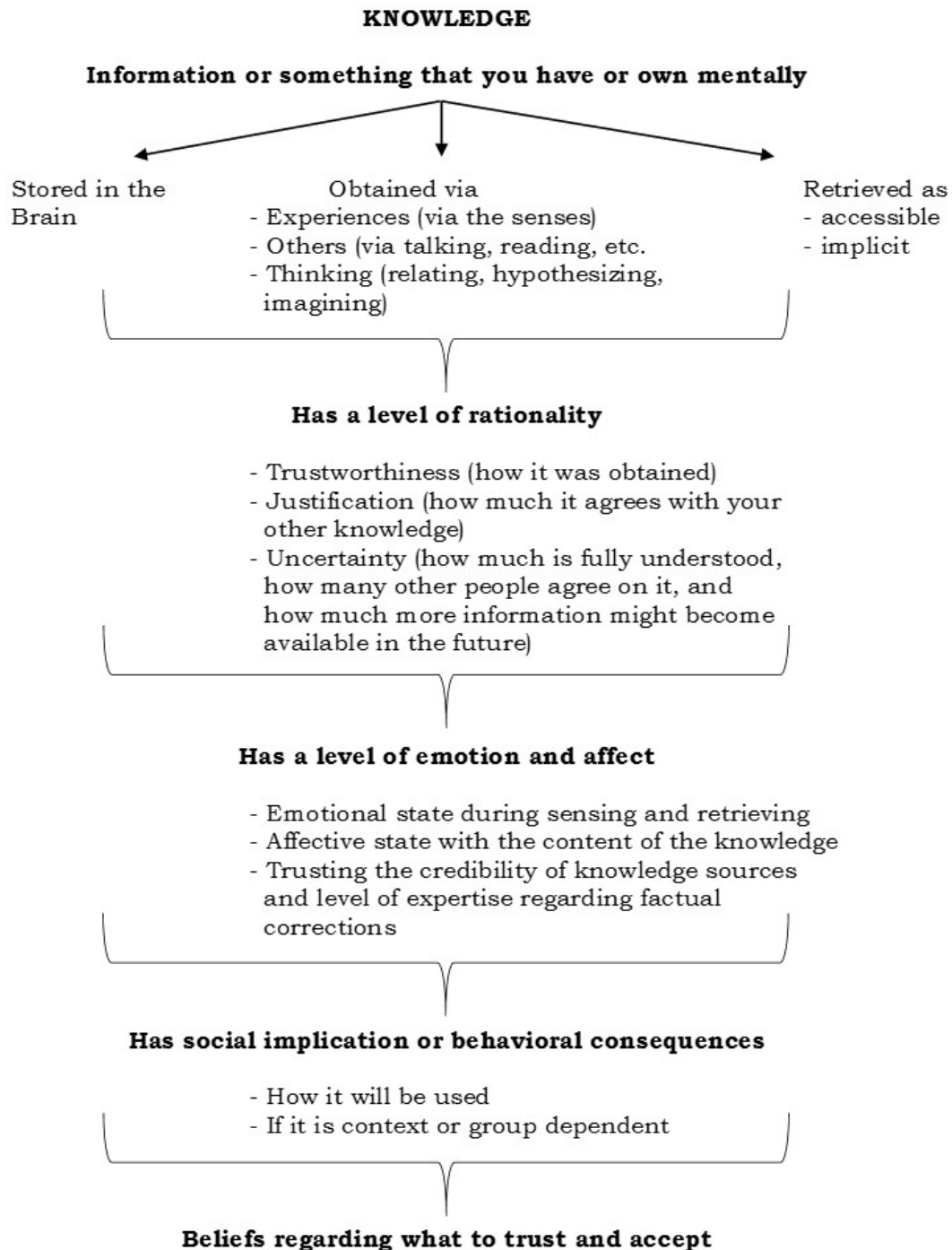
However, the philosophers debate about what is knowledge. Some philosophers disagree with the dominant view that knowledge consists of propositions or facts because they think that it could also consist of, for instance, behavioral dispositions (i.e., the basis of a proposition consists of several observable behaviors). Philosophers also debate about the beliefs involving the truth of knowledge because of their varying in perspective between, broadly speaking, three world views: realism (i.e., objectivism or the world is objective and independent of the human mind), relativism (i.e., subjectivism or the world is subjective and follows what someone believes about it), and anti-realism (i.e., rationalism or the world is not human mind independent nor does it depend on what people believe, in that we can only know it as far as it is possible for us to do so). Yet another philosophical debate concerns the appropriate justifications for defining knowledge. For example, is it sufficient that justifications merely consist of believed good reasons or do they have to be pragmatic, coherent, norm related, and evidence related? Furthermore, some philosophers view knowledge as social institutions (Kusch, 1999), in that certain knowledge is taken to be correct or accepted by a group of individuals (e.g., a state, social class, scientists studying a theory, and friends). Importantly, such groups of individuals can include people who want to preserve or protect this particular knowledge, people who accept it for what it is, and people who want to change it (i.e., they criticize certain knowledge), which raises questions regarding the justification of knowledge, in that not the knowledge in itself but the belonging to a group justifies the acceptance of certain knowledge. Related to this, some philosophers (Khalifa, 2017) also have pointed out that the acceptance of knowledge is irrespective of having a complete understanding of the knowledge, in that people can know something without understanding it; an understanding of knowledge can come in degrees. Therefore, there is neither a philosophically agreed upon definition of knowledge nor of knowledge-as-content.

Regarding the disagreement on a definition of knowledge, there is a question that has been raised by both epistemic philosophers and psychologists (e.g., Chu & Evans, 2021; Harris, 2017; Herfeld, 2022): Can it be that too many different theories, arguments, interpretations, views, and opinions exist as a result of theorizing, empirically studying, and logical reasoning? Can it be, as assumed by science, that these many theories eventually will lead to a better understanding of the actual world, or do we need to do better, such as checking if the original results are flawed (Ioannidis, 2005), including more than some facts and an explanation (Molenaar, 2004; Psillos, 1996), and holding reservations regarding results based on the best explanation of the evidence (Duncan et al., 2014; Ladyman et al., 1997). Perhaps we need to examine knowledge from yet another related scientific domain.

For example, we can view knowledge from a developmental perspective (i.e., Piaget's Cognitive Theory, Vygotsky's Sociocultural Theory, Core Knowledge Theory, Information Processing Theory, and Neural-Connectionist Theory; see Berk, 2012, for an overview). Knowledge develops as a result of our interaction with the actual world. For example, newborn babies have poor visual acuity, but they can see high contrasting areas, such as the eyes and mouth in their parents' face (Braddick & Atkinson, 2011; Hamer, 2016), and in kindergarten, children learn to attach names to the colors they have seen already for some years. Intentional knowledge construction and retrieval is also a result of our interaction with the actual world. For example, middle school students can retrieve previously learned French words during French language classes when asked to do so, and high school students can produce an argument when asked to do so by combining the rules for argumentation with information from years of school training and experiences. Knowledge development, construction, and retrieval are processes, and processes require place and time. For example, when someone asks you for the way to a certain building in town, then you may notice how it first requires some time for you to understand in your mind the exact location of the building and the shortest or easiest way to get there for someone who does not know the way. In this example, the place is the event of you being asked about the route to a building in town, and the time is the duration it requires to retrieve and think through your knowledge in relation to becoming able to respond to the question.

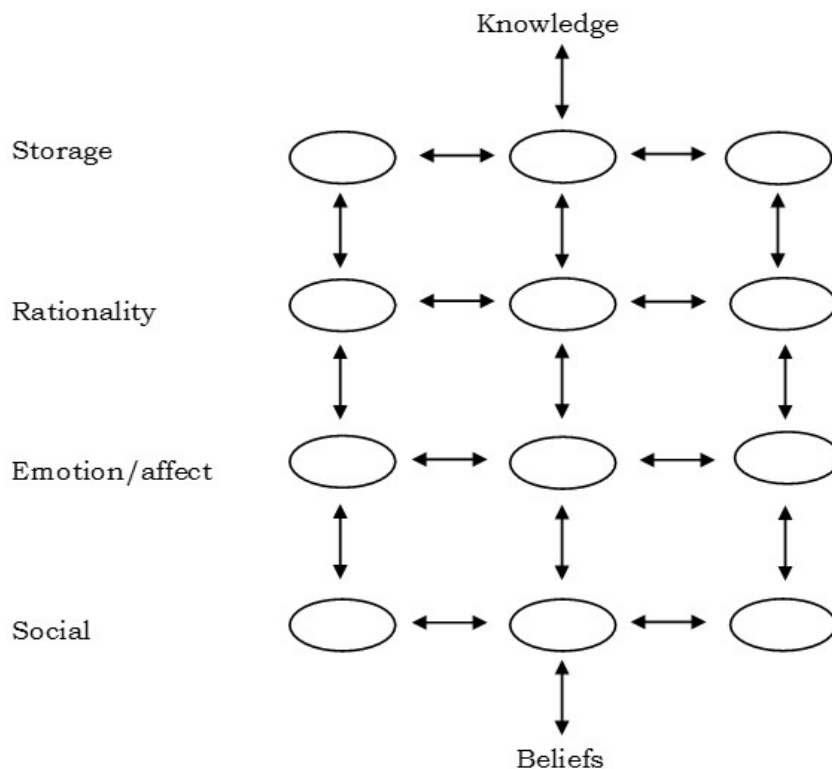
Overall, knowledge development, construction, and retrieval are processes that require place and time to store, retrieve, and use knowledge, but there are also different kinds of knowledge (e.g., the arbitrary names of the colors that kindergarten children learn), and knowledge is related to the person. The theories on human development cannot explain the richness of learning or the construction of knowledge because it is an extraordinary accumulation of places and times that begins with the newborn baby and then continues throughout life in the shape of real-life and personal experiences. Evolutionarily, we are well equipped to pick up quickly those features in the environment that inform us about (possibly) essential conditions regarding our life (e.g., threats, such as danger, food shortage, and rivals, as well as possibilities, such as relaxation, food surplus, and partners). From baby-time on, we have had years to collect knowledge about the actual world that informs us about its objects, substances, temperatures, and colors. Later on, we have added agreed-upon information and information that enables us to think abstractly and rationally (i.e., the frontal cortex of the brain and the use of language and numerical systems). All the information stored as knowledge has come to us via actual-world situations that also have raised feelings, such as being happy, uncertain, overjoyed, and disappointed.

Therefore, obtaining knowledge also involves personal emotional and affective feelings (i.e., the limbic system of the brain), social consequences (i.e., the frontal cortex of the brain), and thoughts or reasoning (see Figure 1).



*Figure 1.* Schematic overview of the psychological and philosophical literature on knowledge.

Although we can sense, interpret, and think about the world that we live in, it also seems that we pick up *certain* things that are happening in the flow of time rather than noticing everything that is happening at that time. In Figure 1, the many layers between knowledge and beliefs about knowledge complicate the full description of what we actually know as a consequence of the continuous nature of time. That is, the processes that influence the description of knowledge in Figure 1 are actually entwined in a continuous recursive developmental process. This is represented in Figure 2, where the double arrows represent a multitude of the possible interconnections across time and where the circles represent a continuous accumulation of information.



*Figure 2.* Schematic representation of the continuous interconnected and accumulated nature of knowledge.

If, as reviewed in this section, we describe knowledge as the stored information of which we believe that we can accept it with a certain degree of accurateness (see Figure 1), then knowledge is a complex phenomenon that involves many interconnected and accumulated layers, as is shown by Figure 2. However, when so many interconnected and developmental changes are possible regarding knowledge, then what does this mean for us humans who are making use of knowledge to exist in the actual world? That is, what is knowledge when so many different “outputs” of knowledge may become possible at a certain point in time in the actual-world situations? We know that knowledge primarily comes forth from our interaction with the actual world. Is it the actual world that primarily triggers which knowledge will

arise to react in a situation? Are other factors than the environment essential for which knowledge will occur, such as timescales, personality, emotional moods, and if so, how then are these factors related to the actual world? And what does this mean for scientists, who attempt to understand knowledge by justifying it, empirically and rationally, in agreement with the actual world?

## **Knowledge and the Actual World**

To answer these questions, what more can we assume about knowledge with a reasonable degree of scientific accurateness? Knowledge, which was described in the previous section as the stored and accumulated information about the actual world that is believed to have a certain degree of accurateness and that involves feelings and thoughts (i.e., involving ourselves and other living species), somehow has to be in alignment with the continuously changing actual world because knowledge helps us to understand the actual world by giving meaning to what we sense from our environment, such as sensing its objects, fluids, gases, light, colors, sounds, temperatures, and movements. More than that, knowledge enables us to place each *perceived* environment (i.e., across time) in the larger context of the Earth that we live on together with other people, flora, and fauna, its history, and its place in the cosmos, in that knowledge helps us to *interpret* the surrounding environment. However, knowledge is not only the stored information about the actual world, it is also a structure of the actual world because knowledge resides in the actual-world shape of the brain, and the human brain perceives the actual world through another actual-world shape, namely the body that can sense the environment.

This also raises some limitations. First, our senses only provide for a window on the actual world, in that we perceive parts of the lights, colors, sounds, movements, and et cetera that are present in the actual world. For example, a dog can hear a larger range of sounds than we can hear, and a honeybee can see a larger range of colors than we can see. Second, the data-collection instruments that we have developed and that are still being improved through technological advances, have enlarged this window on the actual world, in that we now, for instance, understand that the actual world is made up of particles and molecules that can create certain connections, waves, and disorganized oscillations (i.e., nonlinearity and chaos) because they can assemble, collide, engage, and decay. Third, the nature of the actual world is primarily the result of the elapsing of time, and as such, some objects are relatively static (e.g., mountains and buildings can be there for decades) whereas gasses are relatively diffusive and short-lived, some processes occur linearly whereas others can be circularly, and some connections are stable whereas others are catalytic. Therefore, if we search for scientific accurateness in understanding knowledge, a good place to start is the research involving the brain and the body (i.e., cognitive sciences) because this research is closely connected to the nature of the actual world. This section presents several examples of cognitive science research rather than a comprehensive literature overview because the aim is to provide explanations regarding the present state of scientific theories and assumptions in this research discipline.

The first example is about cognitive neuroscience and the required instruments (e.g., chemicals, fMRI imaging scans, and EEG, MEG, and ECoG electrical recordings) because the workings of the brain are not directly observable (see Abraham, 2017; Kalat, 2019; Nobre & Van Ede, 2020; Siegel et al., 2012, for overviews). Neuroscientific

research shows that the brain works at many levels of organization: (a) the different cortical areas for specific senses (e.g., vision, hearing, locomotion, and deciding); (b) the different limbic-system modalities for specific functions (e.g., the hippocampus for memory or learning and the amygdala for emotions); (c) the largely unexplored area of the gray matter areas that lie in between the cortex and the limbic systems; (d) the more than 100 billion neurons in different shapes (i.e., having dendrites and axons or interconnected fibers as well as synapses and neurotransmitters) to guide the electrical impulses; (e) an even larger amount of glia cells to support the workings of the neurons; and (f) the plasticity (i.e., increase and decrease of the branching pattern of neurons) of the neurons at the molecular level. Although it is yet unknown how the brain can actually store information (Queenan et al., 2017), the complexity of the workings of the brain has led to the presently agreed upon assumption that the brain consists of a spatially distributed network of neurons, involving cellular and molecular modifications, that produces impulses (i.e., electrical charge) of neuronal activity to enable gradually varying connections of strengths among the brain's different brain structures. The brain's many levels of organization have led to a description of the brain as a multilayered neuronal network or networks within networks (Kringelbach & Deco, 2020; Vaiana & Muldoon, 2017).

However, this multilayered network is difficult to measure via the present data-collection instruments. Nobre and Van Ede (2020, p. 92 and p. 94, respectively), concluded their summary on the various limitations of neuroscientific instruments as follows: "Brain imaging is most often used to reveal something it cannot" and "It is assumed that the raw, ongoing [brain] activity [measured by EEG recordings] carries no relevant information" and hence it is excluded from data analysis. Regarding the first summary, the indirect markers and timescale differences between brain-imaging techniques and psychological processes (e.g., associative learning and behavior) hide the nuances that otherwise would be present in the data. Regarding the second summary, the series of waves of cortical neuronal electrical activity (e.g., EEG) in relation to brain-imaging techniques and psychological processes leave out the "background noise" in the brain (i.e., by averaging many trials) in the assumption that the brain's ongoing activity does not carry relevant information. But we cannot be certain if these assumptions are correct. What we do know is that the measured cortical neuronal electrical activity and brain-imaging techniques leave out the reaction of how the brain states process external inputs. Overall, the brain is a complex organ, the brain's neuronal activity is extremely quick and interconnected, it is unknown how the brain stores information, and the abundance of data from the instruments requires the cutting down of information as well as a confidence in human interpretation, both of which can cause for misunderstandings.

The second example concerns the scientific disciplines of artificial intelligence (AI) and robotics (see Lake et al., 2017; Marković et al., 2021; Duan et al., 2022, for overviews) that often are closely related to neuroscientific research (Macpherson et al., 2021). AI and robotics is the study of the brain-body-world connection through devising multilayered computer networks and algorithms that mimic the workings of the brain. The research, using computer engineering and simulations, shows that the finding of patterns and the building of models about the actual world becomes possible if there are (a) multilayered structures to reorganize incoming information via either recognition-classification devices or generating-modification of connections devices (e.g., by using conditional probability, predictive coding, feedback alignment, and Hebbian-like rules), (b) generalization models to encounter the world (e.g., built-in

plans for knowledge, language, body overview, working memory, and object detection), (c) deep-learning structures that create self-supervised teaching, and (d) control tools to adjust to the various interactions with the world. However, there is no evidence that the neurons in the brain work in this way. Specifically, the challenges are to create computers and robots that can move and respond as quickly and flexibly as humans can, in that the current systems can produce only limited human-like cognitive abilities.

The main reasons for the difficulties that cognitive neuroscience, AI, and robotics encounter in understanding the brain-body-world connection is that, first, this connection is complex because it not only consists of different structures and waves of energy that are made up of sets of moving molecules and particles and, second, the architecture of the brain, the information from the environment, and the actual world itself are dynamic rather than static. Regarding the first issue, the actual world consist of (sets of) molecules (see Kangasluoma et al., 2020) and particles that are often too tiny and too quick to be detected by instruments directly (Hossenfelder, 2018; Riegler, 2014, for overviews), which presently hinders our understanding of the workings of the actual world. Regarding the second issue, Clark (2019), in presenting a neuronal-computerate overview of the dynamic relationship between the brain, body, and actual world, describes the model of knowledge as information about the actual world that *has become* fixed in the brain. The advantage of having fixed information is that it can help (a) to infer what is being sensed, which is produced by the senses as a set of dynamical stimuli, (b) to interpret what is happening in the actual world because signaling and comparing are made possible, and (c) to adjust the stored knowledge to new situations in the actual world because knowledge is developmental (i.e., it comes with a teaching guide). Again, the present lack of understanding regarding how electrical impulses, synapses, and neuronal networks can become fixed information in the brain, hinders our understanding of the actual brain-body-world connection.

Hence, given that which is present at a certain time and place, the elapsing of time makes things comparable, but also complex and dynamic. In fact, most of the things that are happening in the actual world are primarily nonlinear dynamic or show complex changes in both place and time (Strogatz, 2018). Although this is also relative because it depends on the applied timescale of observation (Van Velzen, 2022), which enables that time can make things comparable. For example, an object is relatively stable, although it will change with time, such as the falling apart of a newspaper and the remains of ancient Greek buildings. These changes of slow decay involve the timescales of decades and centuries. There are also the shorter timescales of quick decay, such as the sudden moments of the crumbling of objects. The human brain can deal with the dynamic actual world, as Clark (2019, p. 273) puts it: “If the world gives our senses a dynamical regime of neural cortical activity, then the internal model(s) can constantly explore the edges of its own territory because the model gives a certain stability.” Nevertheless, interpreting information about the actual world is a difficult and often an impossible task for the brain because of incorrect and incomplete knowledge and the variability of information produced by the actual world in which time is a dynamical constant.

This brings us to the third and final example of the complexity of variability in ecosystems, which has nothing to do with the brain-body-world connection, but it does narrow down the actual world to the closer-situated environment. The study of ecosystems involves the interactions between all the living organisms in a specific

place on Earth. This example is focused on plant-soil interactions, which is an advanced area in ecological science, in that its theories can explain the effects of soil conditions on plant community dynamics and, mutually, plant composition impact on the soil (Van der Putten, 2013). Nevertheless, these theories are hardly useful for actual plant-soil restoration projects as a result of the theories being based on simple summaries of the data, such as the averages and simple relationships between variables (Eviner & Hawkes, 2008). Specifically, Eviner and Hawkes pointed out that plant-soil restoration failures are a consequence of theories that can only point out that a site differs from the average response, but that cannot explain why the responses differ (see Table 1). That the plant-soil interaction theories can explain actual world conditions, but fall short in actual usefulness has led to the development of new scientific endeavors to counter this shortcoming by focusing on, for instance, a multidimensional approach, cross-connections, and functional group of plants (e.g., Gundale & Kardol, 2020; Heinze et al., 2020; Ke & Miki, 2015). Then again, the variability in the actual world is large. Eviner and Hawkes (2008) argued that the many questions that the current theories on plant-soil interactions cannot answer come forth from the complexity and dynamic nature of the actual world and the current scientific methods that are only suitable to discover broad tendencies at best.

**Table 1**

*Some Examples of Questions that Current Plant-Soil Interaction Theories Cannot Answer as a Result of Variability, Complexity, and Dynamics in Ecosystems*

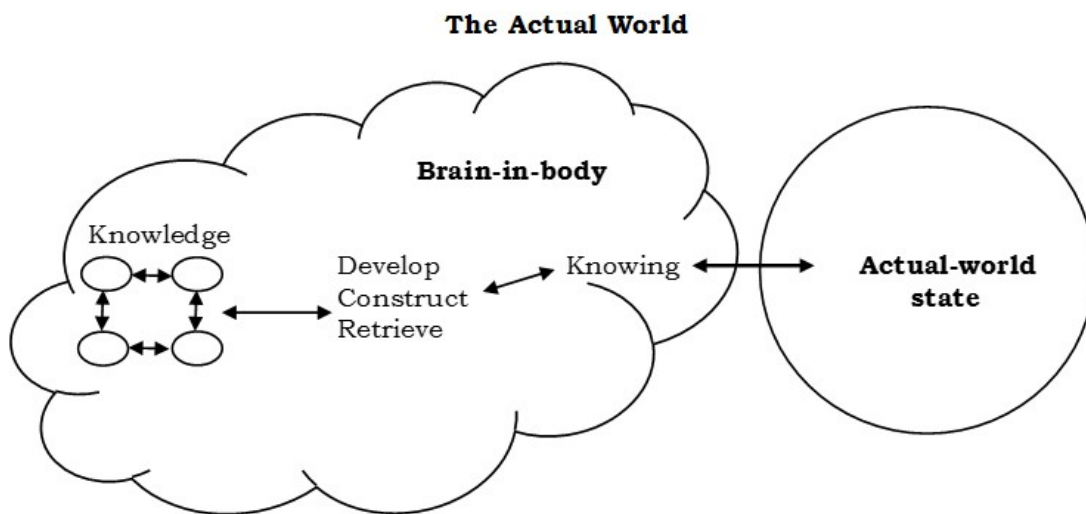
<b>Ecosystem</b>	<b>Subject</b>	<b>Question</b>
Variability	Plant traits	Why can certain plants restore a site: how much of each species are required and where should they be placed spatially?
	Plant response	How do certain plants react to certain neighboring plants?
Complexity	Soil nutrients	Why do certain plants influence soil temperature, moisture, pH, and (in-) organic matter and vice versa?
	Microbial communities	Why do certain plants and microbes influence microbial responses, which in turn then influence certain plants and microbes?
Dynamics	Context dependence	Which shifts in effect of a given species can account for changing local conditions?

*Note.* Adapted from “Embracing variability in the application of plant-soil interactions to the restoration of communities and ecosystems,” by V. T. Eviner and C. V. Hawkes, 2008, *Restoration Ecology*, 16(4), 713-729.

These examples of research that connect the brain to the actual world, of which the third example showed the complexity of the actual world, are useful to illustrate the current scientific difficulties in observing a research subject in relation to the actual world. Specifically, the brain is equipped to process the information coming from the senses to perceive the environment (i.e., cortical areas, midbrain structures, cerebellum, and brain stem) in terms of storing this information as knowledge, but exactly how the brain does this and why it is sometimes and sometimes not possible to

retrieve appropriate knowledge remains a mystery. For example, evidence showed that all kinds of additions, associations, and distractions have been observed when, for instance, educational psychologists assess students' knowledge of school-learned facts (Englert & Bertrams 2017; Nuthall, 2000). In other words, there are multiple theories, but no overall conclusive evidence. The theories merely bring forth broad tendencies. This overall summary of research on brain-body and actual world suggests that the main issues are that knowledge (a) is related to place and time when it develops, is constructed, and retrieved, and (b) is difficult to observe directly. Consequently, as a human being, I do know that I have knowledge about the actual world, I might even be able, up to a point, to explain why I sometimes can and sometimes cannot retrieve this knowledge (e.g., tip-of-the-tongue experience and forgotten), but as a scientist, I have no means to collect data that tells me exactly what my knowledge is, how it is stored in the brain, and why it can and sometimes cannot be retrieved.

This summary raises the question of whether there are some alternative options for scientists who are interested in the study of knowledge, while awaiting for further technological advances and remaining to do research on the details of the brain's functioning and psychological processes. To counter the two aforementioned main issues of knowledge being related to place and time and not being observable directly for scientific purposes, what if we would focus on knowing as the intermediary between knowledge and its function in place and time? In this way, we can make a connection between the store of knowledge that resides in the brain on the one hand and the knowledge that has come up regarding a present actual-world state on the other hand, by focusing on the intermediary function of knowing (see Figure 3).



*Figure 3.* Schematic representation of the actual world involving the human brain in the body and the environment.

In the research literature, different definition of knowing exist, such as defining knowing as (a) a bio-cognitive contextual event in which body and mind are inseparable (Martinez, 2001), (b) an emotional, perceptive, rational, and language-using agency in a world of facts and information that requires interpretations (Davies

& Sievers, 2004), (c) self-knowing about why we think and understand the world as we do (Benson & Griffith, 1991), (d) a disposition for justifying knowledge claims (Kuhn, 2000), and (e) feeling-of-knowing beliefs (Nelson, 1996), such as the tip-of-the-tongue experiences (Abrams & Davis, 2016). What these definitions of knowing have in common are that they all refer to a specific relationship between knowledge, mind, and the actual world, in that certain knowledge is processed by the mind to relate it to the present actual world, and that this is strongly connected to some kind of rightfulness feeling. In the next two sections, an attempt is made to work out a description of knowing that encapsulates the relationship between knowledge, mind, and the actual world by viewing knowing as the intermediary between the knowledge that is stored in the brain and the knowledge that is deemed appropriate or functional regarding a certain actual-world state.

### **Knowledge and Knowing I: The Continuous Presence and Dynamics of Time**

The starting point is that, as aforementioned, the actual world is variable, complex, and (nonlinearly) dynamic, and knowledge and knowing are both part of the actual world via the brain and the body. Knowledge and knowing are also constantly making changes to the stored information (i.e., developing and constructing) to fulfill their function regarding the interpreting of the actual world to produce appropriate reactions (i.e., actions, behavior, and communication). Most researchers are likely to agree that knowledge and knowing enable the long-term storage of information because information about what has taken place in the past can be brought back to the mind. But is this long-term storage ability a state of mind or a process? Is it static or dynamic? Is it comparable to, for instance, a storehouse, cupboard, and diary, where things have a fixed place and can be “viewed” and reconsidered in leisure? The metaphor of a storehouse is common in psychology (Roediger 1980), although it is not yet known where exactly it has its place(s) in the brain (Tee & Taylor, 2021; Van Kesteren & Meeter, 2020). What if it is a storage place and a route at the same time? The metaphor of a route or transportation facility is commonly employed in the neurosciences to explain the neuronal workings of the mind (cf., Hilgetag & Zikopoulos, 2022; Hsu et al., 2021; Mashour, 2018).

If knowledge is a storage place and a route at the same time, then knowledge is the stored information that can spring to mind similar to the way we remember experiences, namely as a time-requiring process of seeing in our minds’ eye a flow of related information. Then viewing and reconsidering your knowledge via the mind with the aim to retrieve certain information may seem like driving along a familiar road that brings to mind not only flashes of stored information with a certain degree of accurateness, but at the same time also other memorized information, such as flashes of autobiographic memories, past experiences involving other persons and situations, present and past feelings (e.g., emotion and affect), and present and past thoughts (e.g., intentions and ideas). Although these flashes of autobiographic memories, past experiences, and present and past feelings and thoughts may only appear at the periphery of viewing and reconsidering our knowledge, they have a function because they can add essential meanings to our knowledge. For example, having botanical knowledge, but also having attached to this knowledge certain autobiographical information about your grandfather’s way of nourishing plants in his greenhouse, can add extra information about what might be prudent to do with certain plants in

certain circumstances. Another example is that certain feelings of insecurity at one time attached to your knowledge about driving a car at night, can support you in making appropriate decisions whenever you are driving in your car.

Of course, now that we are adults, a specific piece of knowledge, such as knowledge about the color of red, can come into our minds immediately and without the flashes of autobiographic memories, past experiences, and present and past feelings and thoughts. That is, when someone has to answer to a question, such as “Which is the color of the flower in this photograph?”, then the name of the color can spring into one’s mind immediately. If the question had been stated differently, such as “What comes to mind if you think about the color of red?”, then similarly the flashes of autobiographic memories (e.g., your first car being red), past experiences (e.g., a red sunset), and past and present feelings and thoughts are very likely to do come into one’s mind. These flashes of related memories, experiences, feelings, and thoughts fall in the category of associations (Nolen-Hoeksema et al., 2020), however, the construction of these associations, as they were first encountered by the brain during infancy, is likely reversed to remembering it at the present time as an adult. That is, during infancy and childhood the different shades of the color called red were attached to specific objects seen in the actual world, whereas adults have seen the shades of red for countless times and have learned to call them red, so that they can retrieve it very quickly without the associations with which they were first stored during infancy and childhood. The way we store knowledge from infancy on may not be the same as the way we retrieve it as adults because we will have suppressed and not retrieved certain information due to it becoming irrelevant, redundant, outdated, damaging, and distressing over time (see Harris et al., 2010, for an overview). Framed in terms of the road metaphor, we may skip certain curves on the road to produce a high way where the also stored associations do not become readily available, in that they “remain outside awareness but can influence ongoing behavior” (Harris et al., 2010, p. 255).

Another reason for why adults may hardly notice that retrieved knowledge is entwined with flashes of related memories, experiences, feelings, and thoughts is that it depends on cues from the context. First, dependence on contextual cues can call into one’s mind the “forgotten” (e.g., not retrieved for some time and suppressed) flashes of related memories, experiences, feelings, and thoughts, such as the aforementioned example of someone asking about the route to a building in town and then while reconstructing the route in your mind, flashes of related memories, experiences, feelings, and thoughts can come to the mind as well. Overall, having a vivid recollection of all the stored flashes of related memories, experiences, feelings, and thoughts is not important to react to many situations, but because it can enhance flexibility in reacting, it can be valuable (Dudai, 2012; Van Kesteren & Meeter, 2020). Second, dependence on context cues can also “change” knowledge due to the arrival of certain flashes of related memories, experiences, feelings, and thoughts at that specific moment, which can result in overrule the coming into prominence of that knowledge. For example, the present context can influence which knowledge and flashes of related memories, experiences, feelings, and thoughts are used to react to the present situation, such as trying to entertain rather than inform and presenting oneself more favorably (Rechdan et al., 2016). The context may also “persuade” some people (i.e., not all people: Miller & Kantner, 2019) to rearrange and even rewrite their knowledge and flashes of related memories, experiences, feelings, and thoughts to respond socially desirable due to, for instance, the task instruction being unclear (Jou et al.,

2020).

A final reason for connecting the viewing and reconsidering of knowledge to the simultaneous arrival of flashes of related memories, experiences, feelings, and thoughts in the road metaphor is that the neuroscientific, AI, and robotics research shows that often multiple cortical areas are involved in cognitive activities (Nobre & Van Ede, 2020). Although the involvement of multiple cortical areas in cognitive activities can also be attributed to the quickness of neuronal impulses and the multi-layering of the neuronal networks in the brain, it may also refer to there being a much higher degree of interconnectedness of all sorts of information than we are currently imagining is happening in the brain. In this respect, humans can also view in their minds eye some piece of knowledge and other information for a prolonged period of time to examine it in more detail. This can refer to certain information in the brain going round in circles via prolonged cycles of certain neuronal activities in certain brain areas. In the road metaphor, this is like bringing knowledge into one's mind as similar to driving along a familiar road where the knowledge and flashes of related memories, experiences, feelings, and thoughts can stay on the brink of the mind until you park the illusory "car" to take a closer look at certain pieces of the flashes of related memories, experiences, feelings, and thoughts. This closer look is enabled by the process of attention. The process of attention can "park" some knowledge, flashes of related memories, experiences, feelings, and thoughts for a certain amount of time, depending on concentration efforts and working memory ability or skill.

Moreover, rather than employing the metaphor of a road with parking facilities for knowledge, it may be more appropriate to visualize it as a three-dimensional cluster of roads with parking facilities that (a) are familiar to a person in terms of having driven these roads before and (b) have parking facilities to focus on certain details, so that this metaphor agrees with the multilayered network of neuronal connections that exist in the brain. Specifically, then the knowing process can bring together certain information from the multilayered network of neuronal connections by doing two things. First, the process of knowing can define which is which by selecting which information is knowledge in terms of accuracy, and which information are the flashes of related memories, experiences, feelings, and thoughts that are essential in terms of informing about the meaning of the knowledge. Second, the knowing process can also select the most useful information regarding the presently sensed actual-world state. This selecting of the most useful information is not the same as the deciding of the most useful information that is determined by the decision process. The decision process determines which parts of the selected information will be used, how this information will be expressed via reacting (i.e., action, behavior, and communication), and which feedback from the actual world can to be expected to validate the appropriateness of the selected information. Accordingly, the decided upon reaction can be performed, which will be connected to the next wave of sensory information that was picked up from the actual world and that requires an interpretation from the mind via the workings of the brain. Hence, the cycle can continue.

In this way, (a) the knowledge and flashes of related memories, experiences, feelings, and thoughts that have been aroused in the mind, some of which are clear whereas others are impressionistic, can be put "on hold" immediately if they somehow align to the incoming sensory information and (b) the parked knowledge and flashes of related memories, experiences, feelings, and thoughts that are put on hold can be viewed and reconsidered for a certain amount of time regarding their present

usefulness and the necessity to continue the illusory driving further along agreeable roads. Consequently, the working of the brain is now perceivable as static (i.e., the presence of organic structures, such as neurons, neuronal networks, and cortical areas that enable “roads” and “parking facilities”) and dynamic (i.e., the electrical impulses and chemical transmission that enable neuronal activity in multiple directions and that can even surpass the existing neuronal networks) to enable the functioning of the mind. This means that the mind that interprets the bodily senses cannot exist without either the neurons or the electrical impulses and chemical transmissions because these organic structures can hold and release past and present information.

The mind is now also perceivable as static (i.e., the scrambled connection of knowledge, flashes of related memories, experiences, feelings, and thoughts that together produce familiar information that is somehow connected) and dynamic (i.e., the launching of the different processes of attending, knowing, and deciding that together can produce the sensation of being able to react to the actual world in a continuous and sensible manner that has, as much as possible, a high degree of familiarity and thereby presents a sense of security). There are several advantages in having a brain *and* a mind that are both static and dynamic, in that the one cannot happen without the other. The brain and mind combined can function (a) in a quick and energetic manner because they consist of neurons (i.e., objects) that enable fast energy transportation, but that can also produce details when attention is focused onto certain information in the brain; (b) completely interconnected because the information in the brain can be retrieved flexibly (i.e., more elaborated than how it was stored in the first place), which suggests that knowledge needs to be related to emotions, language, vision, action, planning, and thinking (i.e., the cortical areas) to create this flexibility; and (c) by giving the impression of familiarity because the actual world that provides for the input of the stored information includes many invariable generalizations (e.g., the trees, water, sun, and people), in that certain knowledge in the brain is much more often reestablished, especially in its generalized form, than other knowledge is.

Therefore, in a practical sense, knowledge is static because it somehow (i.e., as aforementioned, the exact how and why is not yet known) depends on the neuronal connections and cortical areas in the brain, which has as a result that knowledge becomes a given for a person. Knowledge is also dynamic because the waves of electrical impulses and chemical transmissions can somehow (i.e., as aforementioned, the when and if – i.e., does it happen via reorganizing and changing – are unknown) supplement the brain with new information, reorganize the brain by creating new connections, and change the brain by rewriting previous knowledge into new knowledge. The process of knowing is static because it can inform about which knowledge is which information, but it is also dynamic because it can flexibly connect knowledge in the brain in search of information that aligns best with the present actual-world state.

## **Knowledge and Knowing II: Kinds of Variation**

When knowledge and knowing are thus connected to brain and mind, respectively, and to place and time, then it becomes clear that much more can be going on in the brain in terms of remembering than that which is being processed or reconsidered in the mind, which in turn is more than that which is produced via

actions, behavior, and communications. The electrical impulses and chemical transmissions through the brain (i.e., the construction of roads and parking facilities that enable the spread of electrical impulses) are quicker than the processes of the mind are (i.e., for knowing this involves the sensation of driving and the selecting of information), and the processes of the mind are processing more information than the ultimate reaction can reveal. In terms of the road metaphor, the driving is very fast and the (cluster of) roads are relatively familiar, in that the driver (i.e., the mind) picks up flashes of information along the roads, and this leaves the driver with time to reconsider the merits of also driving along neighboring and distantly related roads and the making use of parking facilities. The driver can be restricted to watching glimpses of the roads' surroundings because most roads are familiar up to a point. Similarly, the simultaneously stored information of flashes of related memories, experiences, feelings, and thoughts that are also there, do not have to come into prominence. Nevertheless, they can add meaning to the knowledge that is present on that particular main road.

A consequence of this spread of electrical impulses and chemical transmissions through main, neighboring, and distantly associated roads can be that information that may not have come into one's mind for decades, suddenly can be remembered again because these memories are still there in the brain, in that none of the at one time stored experiences will ever be completely forgotten (see Miller, 2021, for an overview; Wagenaar, 1986). For example, sometimes people can remember an experience from childhood of which they did not even know that they still had this memory. Hence, it becomes clear that it is difficult to study knowledge scientifically when we realize that knowledge storage in the brain involves (a) that knowledge once stored remains stored for the better part, (b) that the retrieving of knowledge depends on the quick flow of the electrical impulses and chemical transmissions through the neuronal networks together with (c) the relative strength of the familiarity of the stored information together with the relative strength of the information of neighboring and distantly related neuronal networks, and (d) the relative strength of contextual cues that were picked up by the senses.

In this section, this issue of the difficulty of studying knowledge is further worked out by distinguishing different kinds of knowledge. When you have to collect as much data as possible to study knowledge as an actual-world phenomenon, then making restrictions by narrowing down the variation of knowledge into kinds of knowledge can be helpful in seeing the forest for the trees. So far, knowledge has been described as information that is believed to have a certain degree of accurateness, that involves feelings and thoughts, and that is stored in the brain, but a description of the content of this information has remained vague. It was only mentioned that the information that is knowledge could be distinguished from the information that contains flashes of related memories, experiences, feelings, and thoughts. Common distinctions of knowledge in the psychological literature (see Camina, E., & Güell, F. (2017; De Jong & Ferguson-Hessler, 1996 for overviews) include general, factual, conceptual, semantic, declarative, procedural, and schematic knowledge. Knowledge can also be arbitrary or based on settlement, in that it may change someday, such as the names of countries. Other knowledge can be formal or acknowledged by most humans as accurate, such as the Earth being a globe. Hence, there are different kinds of knowledge. In line with the road metaphor that was described in the previous section and that mentioned familiarity and relatedness, three exclusive kinds of knowledge can be distinguished, in that they can change into one another across time.

The first kind of knowledge refers to familiar (i.e., often encountered) information about the objects, phenomena, and processes that exist as parts of the actual world, and this familiar knowledge involves self-experienced and agreed-upon knowledge. Self-experienced knowledge is the self-encountered information about the nature of the actual world. It is the kind of knowledge that is closely related to oneself, because it is connected to personal actual-world experiences and in the research literature, this kind of knowledge is often referred to as intuitive knowledge (i.e., in this article it means the stored and directly known experienced-based information rather than beliefs, gut feelings, and implicit knowledge, as there is not yet an agreed upon definition: see Sinclair, 2011, for a review). Stored self-experienced knowledge increases in familiarity when it is often encountered in the actual world, which will make it easier to put it into language. Examples are the self-experienced colors, weather, and flora and fauna as they exist in the actual world, but also houses and buildings, organizational structure of one's work, and travel possibilities via trains and airplanes. Regarding the road metaphor, highly familiar self-experienced knowledge creates highways and well-marked parking facilities. The also stored flashes of related memories, experiences, feelings, and thoughts that are directly associated with this "highway" knowledge can come to the surface in a semi-aware fashion, because they present additional information that can be essential for knowing whether the knowledge matches and is useful for a present actual-world state. In terms of adults' introspection of this kind of self-experienced knowledge, it gives an intuitive knowledge about the actual world that is closely related to someone's personal life and characteristics, but that also can be recalled directly and expressed to oneself and others.

Another familiar kind of knowledge is agreed-upon knowledge. Agreed-upon knowledge refers to the naming and defining of objects, phenomena, and processes of the actual world that is agreed upon by groups of persons. For example, the words red, rouge, rot, and rojo all refer to the same color (i.e., the self-experienced color), although the languages differ (i.e., the name is agreed upon in a certain country) and the names of red, magenta, and mahogany are all agreed-upon names for shades of red. Agreed-upon knowledge is primarily the result of schooling and any other form of social setting that requires the learning or training of specific facts, jargon, and skills. Because of this schooling, agreed-upon knowledge is closely connected to other persons (i.e., being informed by them) and it is essential knowledge because it is required for living together, working, and communicating with other people. In terms of the road metaphor, this kind of agreed-upon knowledge becomes a highway in the brain if the knowledge has been studied and memorized well and employed often. In terms of adults' introspection of this kind of agreed-upon knowledge, it can give the impression of having a databank of words that can be consulted if necessary.

Agreed-upon knowledge is essential in societies. It is the kind of knowledge that is taught because it helps to give descriptions of the actual world, which can include the names given to specific objects, phenomena, and processes of the actual world (e.g., the name ball for globe-like objects and the number one for the quantity of one) and generalized names (e.g., the name tree for all kinds of trees and the name red for all shades of the color of red). Agreed-upon knowledge is often readily available knowledge because it has been either tested via schooling regarding their correct retrieval or is commonly employed in conversations, in that it can be picked up from the brain almost immediately and almost without the accompanying flashes of related memories, experiences, feelings, and thoughts with which it was once stored in the

brain. For example, when I receive a question about whether the red flower in the picture is red indeed, then I can leave out all the other information that I might have associated with the color of red, such as the stored experiences of actual-world flowers and pictures of flowers, botanical knowledge of flowers, emotional feelings regarding the color red in general, and autobiographical memories (e.g., my favorite red car), because my mind knows that this specific question does not require the additional surplus information of my knowledge (see also the third kind of knowledge). Nevertheless, the additional information can have been aroused ever so slightly by the electrical impulses, ever so quickly being overruled by the mind, and as such, it may “flavor” agreed-upon knowledge similarly as it does regarding self-experienced knowledge. For example, it may cause for distractions (e.g., I may need to sell my favorite red car) that can affect my reaction time regarding the next question from the teacher, colleague, and researcher. Then again, years of school training and testing and conversations with other people will have prepared me for situations like this one in terms of minimizing the occurrence of distractions.

The second kind of knowledge refers to complicated information regarding the actual world as well as abstract reasoning, and this complicated knowledge involves complex and understood knowledge. Complex knowledge is the information that consists of multiple combined parts of information, often including varied past experiences, and that requires inferences to oversee and connect it all. In this sense, complex knowledge is often connected to other persons, each giving pieces of information. In terms of the road metaphor, complex knowledge is not like driving along a familiar road, but rather like driving while having to take multiple exits and turnings, which can only be accomplished by also having knowledge about which roads, exits, and turnings have to follow each other in succession to obtain this special route. Often, it has taken years to accomplish these special routes, which means that it can take time to revisit the construction of this route and there is the possibility of making detours and mistakes. These special routes often require a reorganization and rewriting of the knowledge. In terms of adults’ introspection of complex knowledge, it is effortful to bring all the pieces of the required knowledge into one’s mind. Nevertheless, it is the kind of knowledge that can give an explanation of complicated objects, phenomena, and processes of the actual world and enable abstract reasoning. Examples of this kind of complex knowledge are complicated physical processes and extensive judicial laws and ICT operating systems. A more practical actual-world example is walking for 50 miles through an extensive and dense forest without a map and compass and with only the memory of how to continue the route based on the past memories of certain characteristics in the forest.

Another kind of complicated knowledge is understood knowledge. Understood knowledge is the information that can be explained to either oneself or someone else. In the research literature, this kind of understood knowledge is often referred to as integrated knowledge (i.e., synthesizing multiple knowledge representations into a single meaningful model: see Linn, 2006; Schneider, 2012, for overviews), in that it is stored in the brain over the multiple years so that the pieces of knowledge need to be converged (i.e., from different directions in the brain) and diverged (i.e., from the original version in the brain) to construct it as related. Similar to complex knowledge, understood knowledge is often obtained by having to change certain properties of previously stored knowledge to comprehend and explain certain objects, phenomena, and processes of the actual world as well as for applying abstract reasoning. In terms of the road metaphor, understood knowledge consists of a clear road sign on a familiar

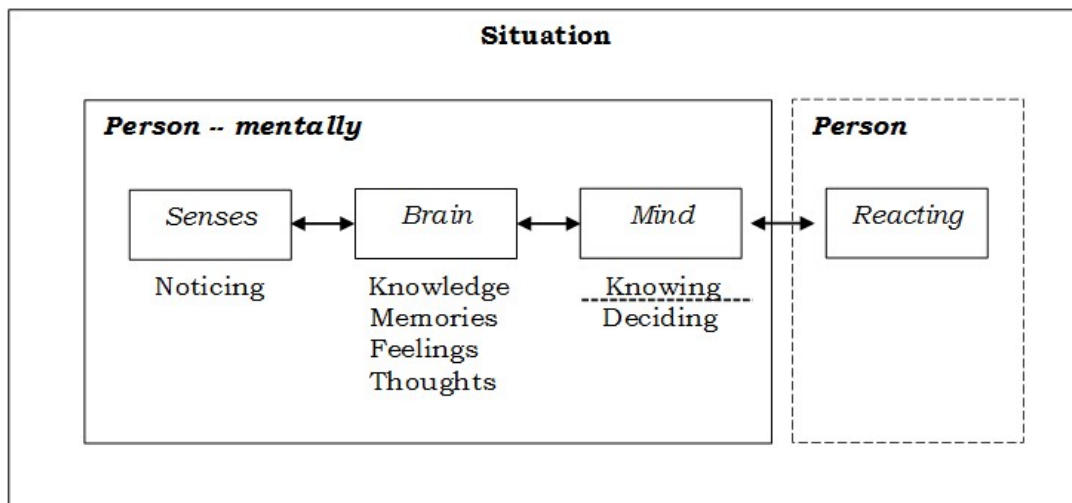
road that leads to a sensibly and logically designed residential area. It may seem like driving along clearly marked and meaningfully connected side roads that make this knowledge sensible and logical. The construction of such a residential area of understood knowledge in the brain can, in the end, only be achieved by the person him- or herself because it requires the restructuring of fragmented and incomplete knowledge into new and comprehensive knowledge. That is, other people can inform and explain about this knowledge, but it becomes understood knowledge for a person only after the penny has dropped. In terms of adults' introspection of understood knowledge, its details and relationships can be explained comprehensively and often also logically. Nevertheless, going through the change process of restructuring previously unconnected knowledge (i.e., involving prior self-experiences and pre- and misconceptions) into completely understood knowledge can cause for misconstruing certain information, and thereby creating hiatus and unnecessary detours. Examples of understood knowledge are the cause of the phases of the Moon, the energy formation of plants, and the avoidance of miscommunication via the rules of grammar and spelling.

The third kind of knowledge refers to conditional information regarding the changes that can occur in the actual world as a consequence of time, place, and other people. Conditional knowledge involves contextual knowledge and expected knowledge, in that both give additional information regarding the actual-world state (i.e., knowledge about which changes can follow the presently actual-world state) and its social consequences (i.e., knowledge about which social behavior is expected). Contextual knowledge is the stored and experienced information about how certain knowledge is related to contextual changes as they have occurred in the past regarding the objects, phenomena, and processes of the actual world. For example, having conditional knowledge regarding the clouds in the sky, which can change into the dissolving and clouding up of the sky, means having knowledge about sun crèmes and rainwear. Because contextual knowledge mostly consists of experienced information about environmental changes, it is primarily connected to oneself, but other people can be involved as the influencers of contextual changes. In terms of the road metaphor, contextual knowledge consists of driving along a road and seeing warning road signs that indicate an important side road with more specific additional information about the possible changes that may occur regarding the present actual-world state. An example in terms of adults' introspection is knowing about the different way in which doors can open to either enter and leave a room or avoid collisions, how swimming in a river may lead up to going with or against the current, and the processes that can lead up to car trouble (i.e., knowledge about cars).

Another kind of conditional knowledge is expected knowledge. Expected knowledge is the stored experienced information about how certain knowledge is related to social encounters. In the research literature, expected knowledge is often referred to as social knowledge that informs about the expectations concerning social competence, which is context dependent (see Junge et al., 2020, for an overview). Expected knowledge mostly involves information about social competence in encounters with other people. Because expected knowledge is stored information about social experiences, it is connected to oneself (i.e., experience) and other people (i.e., informed). In terms of the road metaphor, expected knowledge consists of driving along a road and seeing warning road signs that indicate a side road with important additional social information. In terms of adults' introspection, it is having knowledge about which behavior is expected from you as socially appropriate behavior, such as

introducing yourself when meeting new people and not jumping the queue by the checkout in the supermarket. Another example is knowing in which situations it is sufficient to close a door to have privacy, in which situations you also need to lock the door, and what other car drivers might do when you are encountering traffic chaos.

By distinguishing these six kinds of knowledge, the scientific observation of one or two of such a kind of knowledge in relation to actual-world states can now be narrowed down to a more specialized focus on (a) the degree of storage in long-term memory as a connection to a person's life, personal characteristics, and environment and (b) the distractions that come with retrieving the knowledge. Nevertheless, the *direct* measurement of knowledge is not possible because it's retrieval in the brain goes too quickly and it is strongly related to the present moment. This difficulty of scientifically observing knowledge raises the questions of whether knowing (i.e., which is which, and which is in agreement with the present) about a kind of knowledge can be a suitable alternative because it is more closely related to the actual-world states (see Figure 4) and, because it has come into someone's mind, it can be more communicable and discussible up to a point. Can knowing provide for insights about what the brain has stored as knowledge in terms of its familiarity, complexity, and conditionality? By focusing on the scientific study of knowing, can research possibly obtain an understanding of the motives that mediate knowledge and the reacting to a specific situation?



*Figure 4.* Schematic overview of the theoretical framework for the study of knowledge in the actual world.

In the theoretical framework that is presented in Figure 4, knowing has been characterized as the intermediary between knowledge and the situation from the perspective of a person (see also Fur & Funder, 2021; Pickering, 2013; Scherer & Moors, 2019; Tucker-Drob, 2017; Van Velzen, 2020, for overviews). Knowing fuses the person and the actual world, the storage and the interpretation of information, and the brain and the mind. Knowing enables the first selecting of knowledge that is related to

the actual situation at hand. However, the actual situation at hand will differ from the way humans sense the actual world as the progression of a moment that is being followed by the next moments. That is, the actual-world state differs from the actual situation, in that an actual-world state is in a *continuous flow* of things that are happening and, thereby, producing the actual world, and the actual situation is *a specific* or definable happening that can take its course over one or several actual-world states. That is, the timescale of an actual-world state is in accordance with the tiniest physical change that can take place in the quickest moving objects (i.e., physical particles) of the actual world. This tiniest change that is taking place in the actual world is much smaller than the tiniest change that humans can sense and measure via instruments (Jeng, 2005; Thomson, 2013). An actual situation consists of a larger change in time than an actual-world state does because an actual situation consists of a particular affair that is happening and that can include a succession of events with certain features that are taking place in the environment or surroundings (Van Velzen, 2021a). However, the person is the one who senses the situation (Van Velzen, 2022), in that the person (a) cannot sense *all* that is going on in the actual world of which the situation is part, (b) can sense the situation primarily from the literal place or situational position in the actual world (e.g., inability to see or hear certain actions in the situation), and (c) can sense the situation by accounting for his or her present feelings and thoughts (e.g., remaining on the metaphorical “highway” rather than visiting parking facilities and side roads because of, for instance, feeling tired). The process of knowing brings forward the agreeableness (i.e., not necessarily also the accurateness) of knowledge regarding the actual and personal situation, by checking whether it has aspects that relate to this present situation. As such, the process of knowing can connect information that never before has been connected, in that the exclusiveness of the aforementioned six kinds of knowledge now can become nonexclusive. Accordingly, knowing is followed by the process of deciding or the final aware decision of how best to react by reasoning or thinking things through, so that then the actual reaction can appear as the most appropriate action, behavior, and communication, which sometimes may have surprising elements (e.g., a snap of the moment change in reaction), even to the person himself or herself.

Although the focus on and measurement of knowing can resolve some of the difficulties of directly observing the aforementioned kinds of knowledge, it also raises the question of how to include knowing in a research study that acknowledges knowing as an actual-world process. This question refers to the issues of the measurement of knowing and the place of knowing in the actual world context. The next two sections will synthesize the previous discussion by proposing solutions to these issues of measurement and methodology, respectively.

### **Synthesis I: Measurement Consequences Regarding Knowing as an Actual-world Process**

In line with the discussion so far, the process of knowing can be expected to lead to a twofold of appearances of knowledge in the mind. On the one hand there is knowledge that is highly in accordance with or suitable for the present situation. Because this knowledge has a certain degree of necessity for the present situation, according to a person, it becomes accessible knowledge, to a certain degree, in the mind, and the related information from flashes of related memories, experiences, feelings, and thoughts that are essential to the meaning of this knowledge, can also

become accessible depending on the situation as according to the person. Accessible knowledge and its related information have (non-) verbal language as an aid to make it accessible, because this can facilitate the process of deciding, which requires thinking and reasoning. On the other hand, there is the knowledge that remains somewhat in the background. In the road metaphor, these are the flashes of information when driving along a familiar road and the noticing of parking facilities and road signs without visiting them. This knowledge that remains in the background of the mind may have various reasons, such as it not being very much related to the present situation and the person may not feel like putting effort into obtaining it. Although these reasons might change when the continuousness of the flow of changes in the actual world brings forward its necessity, which possibly is why they remained present in the background at the first place. The knowledge and its related information that stay, for now, in the background are described best in terms of the mental sensation of “flavoring” the accessible knowledge and related information. However, which knowledge in the brain will become accessible in the mind and which will become background knowledge is not yet clear, but it is likely that it will depend on the situation, the person, and the kind of knowledge. Therefore, the degree of accessibility of knowledge in the mind, in terms of its presence as knowing, is worked out further in this section.

The first question that comes to mind is how to reckon with the person in data-collection instruments, because persons differ, they sense situations differently because they differ physically, they store knowledge differently because their brains are different and their experiences differ because of their life history and, consequently, they use their mind differently when they use the process of knowing. This is the question of how to do justice to the individual nature of the participant. When the participant is so highly connected to the measurement of the individual person, then *open-ended* data-collection instruments (e.g., open-ended questions, open-ended observations, and open-ended participant performances) are the most appropriate instruments because they enable the person to state, show, and perform his or her individual characteristics, preferences, and performances. Open-ended data collection refers to giving participants a say in their responding to questions, going about, and tasks. Of course, whether the open-ended data-collection instruments will collect true realistic data will also depend on defining and describing the content under investigation in the instruments in such a manner that it enables meaningful and non-leading open-ended data collection (Pawson & Tilley, 2014) that also (a) captures all the essential features of situations, (b) treats each participant in a similar manner, and (c) enables each participant to react individually and truthfully. A consequence of employing open-ended data-collection instrument is that variables can emerge. The emerging of variables refers to the collecting of data that informs about a phenomenon, in that it provides for additional information on the selected variables of a research study (Levers, 2013; Mason, 2001; Mast et al., 2014). In this respect, emerging variables refer to non-reductionist research approaches, in that taking a holistic perspective can bring forth important information by uncovering that which has been already in the actual world, but that become obscured by focusing on only the selected variables.

With regard to what a researcher can expect when knowing is measured via open-ended data-collection instruments, I can provide for an example, although a rather generalized example, from my own research on metacognitive knowledge (see Van Velzen, 2017; [www.sigmetack.com](http://www.sigmetack.com), for overviews). For the past decade, I have

studied 11th-grade high school and first-year university students' metacognitive knowledge of learning by employing open-ended questions that inquired about what these students know about studying and memorizing effectively by including items that referred to different learning situations and tasks. Metacognitive knowledge of learning was defined as students' knowledge about the effectiveness of study and memorization techniques (see Van Velzen, 2016, for an overview) and by constructing the following kinds of items: (a) how to develop cognitive knowledge (e.g., "I know if I can learn information or subject matter effectively, because I focus on ..." and "I know if a learning technique will work to learn information or subject matter, because I focus on ..."); (b) how to reckon with learning-task demands (e.g., "I know if a learning task will require a lot of practice, because I focus on ..." and "I know if a learning task will be either easy or difficult due to the way it is formulated, because easy learning tasks include ... and difficult learning tasks include ..."); and (c) how to reckon with oneself as a learner (e.g., "I know when I can memorize information or subject matter easily, because I focus on ..." and "I know my strength and weaknesses regarding memorizing, because my strength ... and my weaknesses ...").

Metacognitive knowledge is developed by reflecting on learning situations. An example of an open-ended question on reflection was "When you retrospectively consider if you have understood information or subject matter, then you think about ..." As these examples of open-ended questions can show, the students' knowing about their metacognitive knowledge and reflecting was measured from a generalized perspective (i.e., learning situations in general). More specific was the following also employed open-ended fill-in question: "If I receive a learning task for which I need to ... and ... and..., then I will ... because ..., and I will ... if ... because ..., but I will also take into account ... because ..." The students were asked to fill in as much as possible and illustrate it by describing an actual experience. Although this open-ended question also did not measure knowing about metacognitive knowledge from an actual-world perspective (i.e., not including the personal present state and situation), together the open-ended questions did reveal important insights regarding the knowing of metacognitive knowledge in general.

The importance of these insights on metacognitive knowledge is that they pointed out that it is measurable how students differ *qualitatively* in knowing about metacognitive knowledge. Specifically, explicit access of metacognitive knowledge (Van Velzen, 2012) does not stand alone, in that it related to the degree of having integrated metacognitive knowledge (Van Velzen, 2021b), and using reflection on learning situations in a self-induced manner (Van Velzen, 2015). Nevertheless, these insights do not inform about *why* the students differ qualitatively and *when and why* these qualitative differences can arise in learning situations. By connecting the research results on metacognitive knowledge (Van Velzen, 2017) to the aforementioned six kinds of knowledge, three kinds of knowing are derived: recalling, constructing, and allowing (see Table 2). Recalling refers to producing knowledge about what is present and happening in the situation in a certain degree of explicitness. Constructing refers to producing knowledge that makes connections between what is present and happening in the situation in a certain degree of integration. Allowing refers to producing knowledge about the selection of the recalled and constructed knowledge in a certain degree of expectations about oneself in this situation.

**Table 2**

*The Kinds of Knowing Theoretically Derived From Mediating Between the Kinds of Knowledge and the Results on Metacognitive Knowledge (Van Velzen, 2017).*

<b>Knowledge</b>	<b>Knowing</b>	<b>Result</b>
Familiar - Self-experienced - Agreed-upon	Recalling: “What immediately came to mind about what I know regarding this specific situation, event, and task?”	Access: from implicit to explicit (non-) verbal language
Complicated - Complex - Understood	Comprehending: “What came to mind about what I know about the meaning or intentions regarding this specific situation, event, and task?”	Integration: from making inferences to the checking of mental constructions.
Conditional - Contextual - Expected	Allowing: “What came to mind about what I know about how I would like or not allow myself to be in this specific situation, event, and task?”	Agency: from following others to self-induced mental behavior.

Importantly, the actual reaction to the situation (i.e., or the events and tasks in that situation) in terms of behaving and performing might be different up to a point from that which came to mind regarding knowing, because the decision process that follows knowing can have as a result a change of mind. First, the decision process comes after the knowing process and, thereby, can include the information from more than one knowing session because of following different timescales. The information in the knowing process has a smaller timescale than reacting has because the electrical impulses are faster than actual activity, communication, and behavior, in that not all of the knowing information can be made explicit. Second, the decision process can overrule certain information obtained via the knowing process for a particular reason (e.g., gut feelings and boredom). Overall, these theoretically derived kinds of knowing can be helpful in narrowing down the data from the open-ended questions on knowing, in the assumption that these questions leave room for alternative responses. That is, they can be helpful as a first guide for the data analysis, but they should not steer the data collection in terms of constructing items that measure what one intends to measure.

The next and related question that comes to mind is how to reckon with the person in the actual-world situation because persons view an actual situation from their own perspective (i.e., their near-present state and their place in the situation). This is the question of how to do justice to the participant who is participating in an actual situation. That is, aside from collecting open-ended data that informs about kinds of knowledge, knowing, and its related constructs, the data collection also requires to obtain information about the context of the person in relation to the situation (see Figure 4). The advantage of including *the context* via measurements is that it enables the researcher to rule out alternative explanations regarding data interpretation (Adcock & Collier, 2004; Messick, 1995). However, including the context regarding the person in the situation for data collection can result in obtaining a large variety of different contextual perspectives, which can lead to non-informative data.

This issue of obtaining a large variety of contextual perspective can be solved by distinguishing between the objective and subjective character of the contextual variables to disentangle the information about the person-in-the-situation from the actual situation to facilitate the identification of groups. For example, inquiring about the context can produce data that reveals subjective contextual information (i.e., those contextual components that the participants vary in) and objective contextual information (i.e., those contextual components that the participants agree on), of which the latter kind of data can be supplemented, if possible, with an objective measure of the actual situation, such as a video). This distinction between objective and subjective context can support the data interpretation of the collected psychological variables related to knowing and it can also enable checks regarding specific and included bias variables (e.g., the researcher checking for Hawthorne effect, social desirable responses, and cognitive editing) because the deviation between objective and subjective context can provide for explanations regarding the interpretation of the variables. In this way, not only the generality of results and findings, but also the limitation of open-ended data-collection instruments (i.e., it requires the interpretations of the researcher) can be reduced in terms of improving the falsity of observation statements due to having included a secure basis for the scientific observation of actual-world phenomena.

Both the complexity of knowing and the distinguishing between objective and subjective context will, most likely, require multiple measurements. In the research literature, much has been said already about employing multiple measurements at the same data-collection moment to assess a theoretical phenomenon (e.g., triangulation), such as the advantages of refining and validating assessments and the risks of increased measurement error (cf., see Crosswell & Lockwood, 2020, for review) and, regarding composite outcomes of theoretically related variables, the advantages of obtaining finer assessments due to less measurement error and more meaningful comparisons, and the risks of retest effects and exacerbation of certain influences, such as fatigue and boredom (see Moreau & Wiebels, 2021, for a review). When the measurement of knowing consists of multiple open-ended data-collection instruments that (a) enable participants to respond individually and as naturally and truthfully as possible and (b) include data collection on the objective and subjective components of the context, then it becomes possible to obtain insights about knowledge as an actual-world phenomenon because the phenomenon is studied in its context by including related processes, person, and situation.

However, as indicated by the double-arrows of the components in Figure 4 and as discussed regarding the timescales of the processes of noticing, knowledge, knowing and deciding, and reacting, there is a continuous flow of information from the environment. For example, because reacting takes place in the situation that has continued, it can deviate (somewhat) from that which was decided in the decision process (e.g., act on the spur of the moment). This continuing of time in the actual world can further complicate the data collection, in that there can be loss and recovery of knowledge during the mental processes knowing and deciding as well as during reacting because the situation has moved on. This issue is worked out further in the next section.

## Synthesis II: Methodological Consequences Regarding Knowing as an Actual-world Process

The issue under discussion in this final section involves the question of how to include in a research study the context or actual-world situation as it influences the process of knowing. This question is legitimate because knowing was defined as a process that connects knowledge to the actual world and, hence, the influence of the context can be assumed. The main difficulty in including the context in research on knowing is that other related processes of the mind (i.e., deciding and reacting) closely accompany the process of knowing and these processes might function on different timescales depending on the person in the situation. Therefore, the issue in this section deals with the measurement of the many facets involved in capturing the changes of the actual situation and (groups) of persons retrieving their knowledge.

Aside from the aforementioned open-ended data collection and the kinds of knowledge in research on knowledge as an actual-world phenomenon, the context in terms of situational changes that can influence the retrieval of knowledge through knowing, which involves objective and subjective information about the situational changes, can be assessed by involving four lines of measurements as illustrated in Figure 5. The first moment of measurement involves the situation-as-it-is or the starting point regarding the situational changes. In the previous section, this is the information about the situation that participants can agree on and which is objectively established. In the beginning of the research study, each individual participant forms a picture of the research situation (i.e., being in a data-collection moment and having to produce responses), which is illustrated in Figure 5 by the vertical beam labeled as the situation-as-it-is. Accordingly, the data collection (i.e., session(s)) continues in time, which is illustrated in Figure 5 by the horizontal top line of the situation-as-it-is and the horizontal beam labeled as  $P_i$ -situation. The  $P_i$ -situation includes the information about the changes in the situation according to the individual participant. These two kinds of data collection produce the relative objective information about the situational changes.

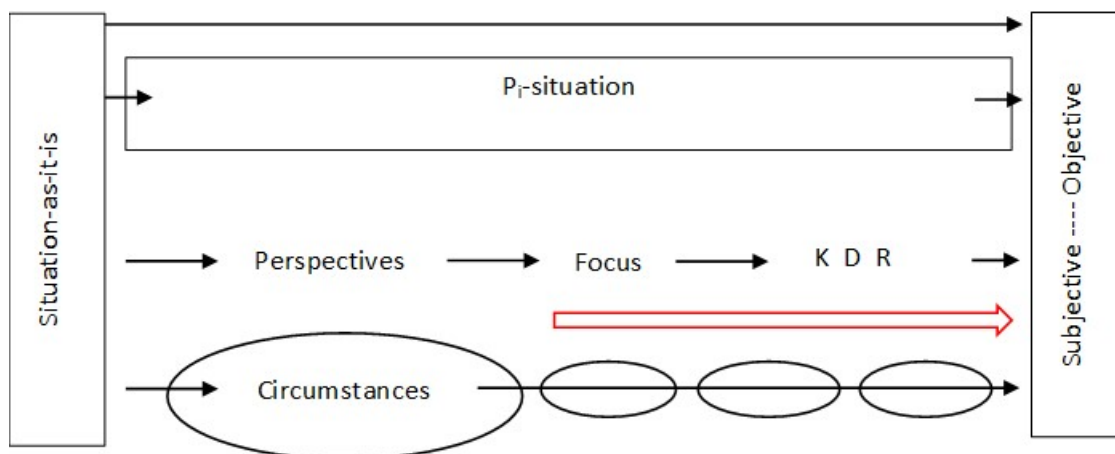


Figure 5. Schematic representation of the situation in the research study on knowledge as an actual-world phenomenon.

The individual participant's interpretation of the situational changes that take place in the actual world is assessed by the next two horizontal lines in Figure 5, namely the data collection involving the perspective of the individual participant and the data collection of the circumstances according to the individual participant, respectively. The perspective of the participant refers to the retrieving of knowledge via the mind, which will be assessed primarily via the process of knowing, but this process begins with the participant's perspective or interpretation of time and place (e.g., purpose and tasks) in relation to personal characteristics concerning the functioning of the mind or the ability of concentration, working memory, and learning or knowledge construction.

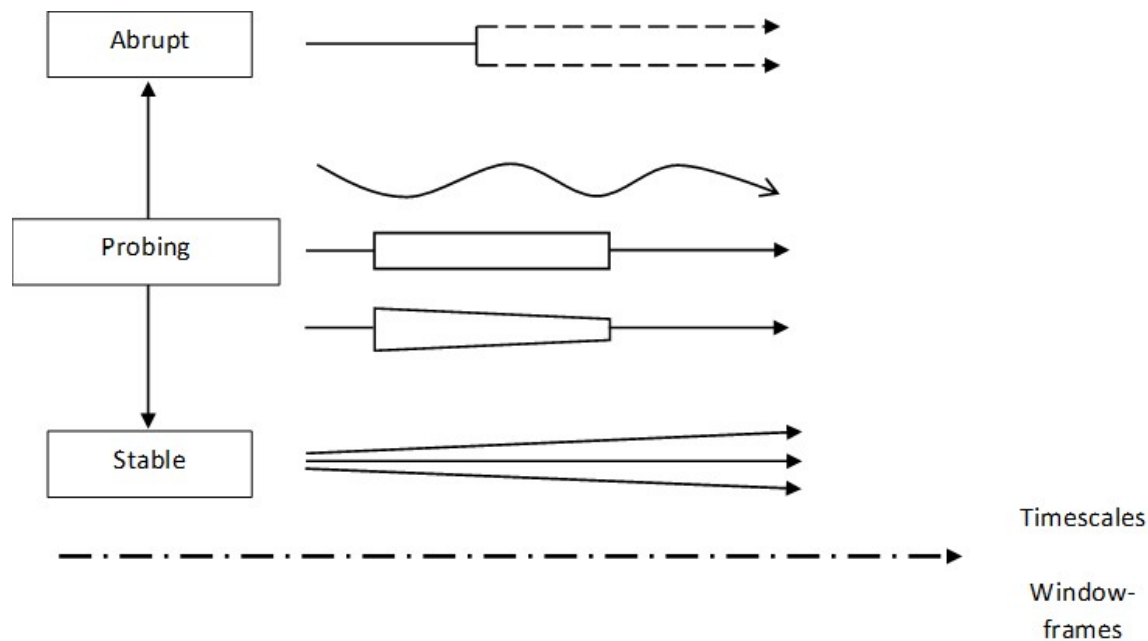
The participant's perspective on what to do with the  $P_i$ -situation leads to emphasizing certain part(s) of the situation, which will set up a focus that can include expectations (i.e., interpretation of what is being expected), intentions (i.e., interpretation of how to react in line with one's self-image), and goals (i.e., interpretation of the desired final performance or self-image). Accordingly, this focus will influence the processes of knowing (K), which in turn can somewhat change during the processes of deciding (D) and reacting (R), such as the aforementioned acting on the spur of the moment. The final horizontal line of circumstances refers to the individual participant's interpretation of near-present day experiences that contains the hustle and bustle of daily life in relation to thoughts and feelings about oneself (e.g., personal health and family) in the situation (e.g., news reports and colleagues' behavior), which can produce, for instance, distractions and moods. The connection between the perspective-focus and circumstances is illustrated in Figure 5 by the red arrow to indicate that this connection is more subjective than the connection between the  $P_i$ -situation and the perspective-focus and circumstances because most persons remain close to their personality or self-image as it is at a particular life period (Harris et al., 2016). In this way, the elapsing of time during data collection is captured via four kinds of measurement that are mutually exchangeable in such a manner that they can inform about the relationship between the objective and subjective changes and influences within the data-collection situation.

To explain further the necessity of including circumstances in research on the actual-world phenomenon of knowledge is that circumstances differ from the  $P_i$ -situation (i.e., the changes in the situation according to the participant), in that the variable of circumstances emphasizes the *internal* personal state as a consequence of situations prior to the  $P_i$ -situation. Circumstances also differ from perspective taking regarding the retrieving of knowledge to react in a situation, in that expectations, intentions, and goals are related to circumstances (e.g., being distracted by recurrent thoughts about impressive news reports of the day before), but also can be overruled by the person (e.g., putting the news reports aside by deciding not to let them reoccur in one's mind for the present time). The three different aspects of the situation as illustrated in Figure 5 are all interconnected, but they can have different timescales and as such can inform or explain the overall influence of the situation on knowledge retrieval. As aforementioned, knowledge retrieval is always influenced by the situation. The function of including circumstances in research is that it enables (a) the bridging of the different timescales of the situational changes that are objective, objective-subjective, and subjectively personal-internally based and (b) temporal window frames. Temporal window frames (Buehner, 2005) are the individual's ascribing of a certain length of time to a situation or an event in a situation due to the presence of

personally essential or attention attracting incidents. Temporal window frames can also account for the subjectivity of situations, due to the fact that bodily senses and mental processes requiring time to observe and interpret the surrounding actual world. Temporal window frames bring the elapsing of time to an imaginary stop that is individually meaningful. This makes temporal window frames more closely related to the content of the processes of knowing, deciding, and reacting (i.e., the personally perceived time) rather than a strict tempo of time (e.g., time as indicated by a clock). Therefore, data collection on circumstances can provide for essential information regarding the individually emphasized situational changes if the participant does not regard it as a possibility to construct excuses for certain actions, behavior, and performances.

Although the three kinds of situations can support researchers in obtaining information about the influence of context or situations on the research subject of knowing, it remains essential to establish the correct timescale(s) for the data collection points in time of either one or multiple data-collection sessions. The accurateness of the selected timescale in a research study (see Walls et al., 2012, for an overview on considerations) depends on a precise description of the research situation and the execution of the research procedure required for answering the research question(s). The selection of the timescale involves the differences in the sequence of steps in time (e.g., using clock and calendar) regarding the data collection of the research situation, the participants functioning of the mind, and the participants circumstances. In general, the smaller the timescale in terms of the amount of time between two data collection points in time, the richer the information about the consistency, change, and consequences of the context of the participants (Pulkkinen & Kokko, 2012). A small timescale is also useful when little is known about the participants' possible changes and the context. However, a small timescale can overburden the participants and multiple data collections can result in retest effects (Scharfen et al., 2018). Therefore, the selection of timescales is a necessity and it is essential to be obtain it as accurately as possible, but it also contains an estimation, to which a triple subdivision of the variable of context can be helpful in terms of narrowing down the elapsing of time by collecting bridging information.

The capturing of the changes in the context via the three kinds of data collection in Figure 5 can provide for an identification of the connections and explanations regarding the process of knowing and the related processes of the mind. Aside from finding connections and explanations that can describe what is happening for which reasons across time according to the individual participant, it can also lead to establishing inter-individual differences based on this data by focusing on *kinds* of changes across time in the connections between the process of knowing and the influence of the context. By demarcating change in knowing and context as a certain pattern of temporal difference in position, course, and direction, rather than a statistically significant change, can produce a first interpretation of what is happening regarding the retrieval of knowledge of an individual in a specific context across time. This can facilitate the grouping of participants that have a similar change pattern and, thereby, encourage the discovery and selection of those variables that are essential for several persons and, in this way, inter-individual information can arise that is independent of the priori established research variables (i.e., of expected concepts and constructs) and group models (see Molenaar, 2004; Rovine & Lo, 2012, for a discussion). The kinds of adaptive patterns to situational change that can arise as a consequence of the elapsing of time are illustrated in Figure 6.



*Figure 6.* Schematic representation of the five kinds of human adaptive responses to situational variation across time.

Figure 6 shows five kinds of patterns of adaptive responses to situational variations in the actual world that involve a relatively stable, probing, and abrupt reacting regarding the influence of the context on the retrieval of knowledge or knowing. In Figure 6, the five kinds of adaptive responses to situational variation are illustrated as taking place across time, but they can vary in intensity from having a small up to a large degree of change (i.e., Figure 6 does not have a defined y-as). The first kind of adaptive response is relatively stable and refers to the relative continuation of the pattern in the same position and direction (i.e., illustrated by the three straight lines at the bottom of Figure 6). It shows a relatively steady pattern across time that indicates that the influence of context on knowing is considered to be approximately the same, in that it can deviate slightly towards an increase and decrease of contextual influence on knowing. Next, there are three kinds of adaptive probing responses that indicate a varying and systematic influence of context on knowing. The first probing response involves a change pattern of temporarily converging alternated with diverging (i.e., illustrated by the wave-shape arrow in Figure 6). The successional converging and diverging shifts in pattern can be smaller and larger in degree across time, but they never revert to a stable and new pattern, in that the pattern remains to be dynamical. The second probing response refers to a periodic dynamical burst in a relatively stable pattern that indicates that the influence of context on knowing is undecided for a demarcated period of time. The third probing response refers to a periodic burst in a relatively stable pattern of gradually converging to another relatively stable pattern. Finally, the fifth kind of adaptive response refers to the rather abrupt or sudden change into a completely different or new response as a consequence of the influence of context on knowing. This distinction in five kinds of

adaptive responses to situational variation across time as experienced by the participant can be helpful in searching for groups of approximately similar participants (i.e., inter-individual grouping) because simply taking averages per data collection moment may not reveal the way in which the changes that occur as a consequence of what is happening in a situation as according to the participant.

Overall, the subject of context or situatedness in research has faced difficulties because of the large variety of possibilities that can emerge when the situation is taken into account in research to obtain an understanding of an actual-world phenomena and process. This difficulty has led to research that includes a priori described actual-world situations (e.g. an invented learning scenario as the item in a data-collection instrument). The risk of employing a priori described actual-world situations in research studies holds the finding of broad tendencies as a consequence of having too much control in the research study, in that it may not be similar to what students do in actual-world situations. Another response to the difficulty of including the situation in research is by letting actual situations emerge (e.g., naturalistic and holistic research). The risk of letting actual situations emerge in a research study refers to obtaining too little control and not finding anything in the abundance of data. There has to be the golden mean. To reach this golden mean, the specific purpose for including the context or situations in a research study should be clear by stating, if possible, which facets of the situation (i.e., situation as it is, P<sub>1</sub>-situation, and circumstances) need to be assessed for which reason. The overall purpose of including the context or situation in research is to obtain an understanding of the mechanisms behind, or the basis of, the functioning of phenomena and processes in the actual world. When there is a better understanding of what a situation is (see also Van Velzen, 2021a, 2022), and its main components can be measured as illustrated in Figure 5 because it includes objective and subjective measures, then the risk of too little or too much control has been narrowed down to improve a reckoning with the nature of the actual world.

## Conclusion

What is knowledge? Knowledge is what you know because you have it stored in your brain as information that has a certain degree of accuracy. However, to retrieve knowledge depends on the kind of knowledge, the way it is stored in the brain in terms of its relationship with yourself (i.e., your experiences, feelings, and thoughts), and the situation. Specifically, it is the situation that influences (a) which kind of *knowledge* you retrieve from your brain, (b) how susceptible you are for *distractions* in terms of starting to retrieve other knowledge and experiences, feelings, and thoughts and (c) what you, accordingly, *decide* to do with the retrieved knowledge in terms of reacting. The situation determines the retrieval of knowledge, distractions, and decisions, which can become obvious to the participant via the process of knowing.

There are various kinds of situations because the actual world is continuously changing as a consequence of the elapsing of time. In this article, it was argued that, despite the complex and dynamical nature of situations in the actual world, research can take into account the diversity of situations in the study on the nature of knowledge because, due to human common agreements about the actual world, the relative stability of personality for a particular time period, and the use of temporal window frames, humans react to the dynamical nature of the actual world with just a

few kinds of adaptive responses to situational variation. To this end, depending on the kind of knowledge under investigation, the situation can be included in the study on knowledge in a triple way: (a) the situation as it is; (b) the situation as it is interpreted by the participant and that will affect the perspective and focus of the participant; and (c) the personal and situational circumstances that have a major influence on the situation as interpreted by the participant. It was argued that this division in three kinds of situation for scientific purposes could produce information about the objective and subjective facets regarding the actual world and provide for explanations about why which knowledge is retrieved by certain persons in certain situations.

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### Footnotes

<sup>1</sup> The experimental philosophers of the twentieth century are doing cognitive science (Knobe, 2016), however, this gives them the opportunity to obtain empirical evidence that is more closely tailored to their questions on subjects than having to argue logically regarding the empirical evidence collected by colleagues from other scientific disciplines than philosophy. In this article, only the philosophers employing logical argumentation are included.

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### Author Note

Joke H. van Velzen, Research Institute of Child Development and Education, University of Amsterdam. Correspondence concerning this article should be addressed to Joke van Velzen, e-mail: [j.h.vanvelzen@sigmetack.com](mailto:j.h.vanvelzen@sigmetack.com).

### Conflict of Interest

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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