Towards the measure of *all* things – Why we need to apply the scientific method directly to the mind

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Towards the measure of *all* things – Why we need to apply the scientific method directly to the mind

The great gulf between physical and psychological research persists only when we acquiesce in our habitual stereotyped conceptions

-Ernst Mach[1]

The development of more sophisticated methodologies for investigating first-person data and of formalisms for expressing them is the greatest challenge now facing a science of consciousness

-David Chalmers[2]

[1] (Mach & Wolters, 2008, p. 17)
[2] (Chalmers, 1999, p. 10)

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Introduction

To start I have to make a couple of remarks about the title of this essay. The first part – "Towards the measure of *all* things" – was not chosen to arrogantly depict this essay as the measure of all things. Far from it! The scope of this essay is intentionally broad synthesising many different strands of thought which means that the limitations and shortcomings, especially regarding the possible level of detail with which each topic can be discussed, are blatantly obvious.

Instead the title was chosen to convey the virtue of seeing the world in terms of measurements and conceptualising ourselves in terms of a measurement apparatus. This view allows us to explore the idea that what manifests as the world has a lot to do with our individual ways of measuring. The ideas of measurement and information will feature heavily in this essay, especially in part one.

This first part of the essay will investigate our ontological and epistemological assumptions about the world and the self. I will start the discussion with a number of ontological assumptions which seem so intuitively true to most of us that I will call them default ontology. These assumptions are realism, the belief in a mind-independent objective world out there; the conceptualising of the self in terms of an entity; and various kinds of dualism. This worldview could also be called substance ontology since it focuses on entities and things.

Following the description of this default ontology I will look at arguments from many different traditions which have criticised our default ontological assumptions. These range from Eastern and Western philosophy, psychology and neuroscience to modern physics. Since this is an essay about the importance of exploring our experience directly I attempt to refer the reader to his or her own experience as much as possible, using examples, analogies or little experiments which may help make the theoretical concepts more graspable.

At the end of part one I will sketch a different set of ontological assumptions which focus on process, measurement and interaction rather than substance. One might call this view measurement ontology. As we will see, this worldview implies that we are not passive observers of a pre-existing world but instead are active participants necessarily involved in the continuous co-creation of an emerging world.

Coming back to the first part of the title, it is also a kind of pun as pointed to by the italic "*all*" suggesting that within science we are currently not measuring all

things possible but instead limit ourselves to a certain set of phenomena. A central argument of this essay is that we have to *expand our scientific horizon as well as our methods* to include and accommodate phenomena not currently systematically investigated.

This leads us to the second part of the essay and the title: why we need to apply the scientific method directly to the mind. This might cause you to pause and think: don't we already do that? You might suggest that cognitive science – the collaborative effort consisting of psychology, phenomenology, neuroscience and philosophy of mind – is already doing that. Well, yes and no. I am not trying to criticise or even diminish these fields of inquiry. They are arguably the most fascinating fields within science. What I am saying, however, is that there is a certain research area which has been largely overlooked by cognitive science, actually the whole of Western science, for a variety of reasons, historical, philosophical and methodological in nature.

The direct science of the mind I claim we need is a branch of science which looks at our own minds in exactly the same way as science already looks at outer phenomena. In addition to looking at correlates of mental events, (e.g., studying the brain and behaviour), which cognitive science is already doing, a direct mind science sees our awareness itself as a laboratory and our thoughts, emotions and other mental content as observable phenomena. It also considers the possibility of refining our measuring capabilities and experimenting with mental states. I will advocate that in light of the discussion of part one, we need to apply the scientific method directly to the mind to become more aware of the measurements we are making on a daily basis and the world which is brought forth in accordance to those measurements.

I refer to this branch of science as inner science or inner psychology. The main goal, maybe the only goal, of this essay is to show that such an *inner psychology is necessary and feasible*. But before we get to this part about methodology we have to start with our ontological and epistemological assumptions because these assumptions have a big influence on the methods we use to investigate the world and the mind.

1 Philosophical background - from default ontology to measurement ontology

1.1 Default ontology

I will begin our philosophical journey with a look at some ontological assumptions many of us share. In order to make our ontological assumptions explicit and graspable I will begin the discussion with my momentary content of consciousness.

At this moment I can see my laptop in front of me and the side of the room I am facing. I am also aware of the sun which shines through the open window onto my desk. I hear some birds singing outside. I feel the haptic feedback of the keys on my laptop. I am also aware of a slight feeling of hunger and some thoughts about food and writing.

We can take this momentary content of consciousness and see whether we can become aware of some intuitions about the way this content exists. Husserl pointed out that when looking at the world, we usually have a certain view which he termed the “natural attitude” (Husserl & Kersten, 1982). Within this natural attitude we see the content described above – physical objects, thoughts, feelings – as simply real and straightforwardly existent (Husserl & Kersten, 1982). They seem to just be there. This attitude is usually so ingrained that we do not recognize it as a perspective but view this simply as the way things are (Husserl & Kersten, 1982). One could describe this natural attitude as a kind of *default ontology*, the way we usually believe things to exist. Taking my perception of the sun as an example I will expand on our default ontology and make some aspects of it more explicit. Regarding my relationship to the sun there are a number of aspects which seem blatantly obvious to me. See for yourself whether your intuitions are similar to mine.

The first aspect can be called realism. It is twofold consisting of *metaphysical realism and naïve realism*. Metaphysical realism is the notion that there is a reality which exists out there independently of the observer. There seems to be this thing-in-itself which exists apart from all our frames of references and ways of perceiving it. Regarding the sun I have the strong intuition that the sun would still be there no matter if I or anyone else currently perceives it or if I along with all other sentient beings would cease to exist. Naïve realism refers to the belief that my senses provide me with direct awareness of objects as they *really* are. This notion states

that the nature of the sun is just how I perceive it, that my perception of the sun is more or less accurate.

The second intuitive aspect of our default ontology is the belief in the notion of a *self in terms of an entity*. This self seems to be unitary, immutable and independent. It seems unitary as there is only one self, me. It is immutable as it is unchanging and different from all the changing phenomenal content of my experience. And it is independent as it seems to exist apart from other entities such as the sun. My self seems to be encapsulated in my skin and it is constituted of my body and my mind. In the case of my relation to the sun I see the sun as an object and myself as the entity which perceives this object.

The existence and interaction of the first two aspects – a metaphysically real world existing apart from our perceptual schemes – and the notion of a fixed self, a kind of canvas on which the world is plotted – are an example of a form of the third aspect of our default ontology which is usually referred to as *dualism*. The subject-object dualism has already been touched upon in the paragraph above. Other dualistic notions are internal and external, mind and matter or subjective and objective phenomena. Looking back at the example of my content of consciousness, suns, birds and laptops seem to be external and material. My feeling of hunger and thoughts about food on the other hand seem to be internal and mental. Matter seems to belong to the realm of the objective; it seems to be publicly observable. Thoughts and feelings in contrast seem to be subjective and only directly observable by me. The two kinds– physical and mental – seem to belong to completely different categories. It seems that we all are natural-born dualists.

These aspects of our default ontology seem very natural and are very ingrained in our language and also in our scientific practice. However, all of these aspects have been called into question from various philosophical traditions and scientific disciplines.

In the following sections I will review our default ontology in detail and review some of the major criticisms it faces. To do so I will use practical examples, analogies and experiments with the aim of enabling the reader to grasp the potential faults with our default ontology intuitively. This will be followed by a more technical discussion of an alternative ontology. The discussion of ontology and epistemology is not an end in itself but rather a means to an end. This end is the methodological

discussion in the second half of this essay which talks about the implications of our ontological and epistemological assumptions for science and philosophy.

But before going into detail regarding these aspects I will shortly look at another example in which our naïve worldview has been proven not to be the most accurate predictor of reality. This example is the Copernican revolution in astronomy. This discussion will not only serve as an analogy to the paradigm shift I believe us to be in the midst of but also show why ontological assumptions about the world have consequences for the kind of research we are conducting to investigate that world. Furthermore, our intuitions about the self and the external world and about the way in which the two interact can be likened by analogy to our intuitions about the planet we inhabit and its place in the universe. The example of the Copernican revolution has been used by Wallace (2007) and Russell (2005) to make points similar to the one's I am making and has served as the prime example of a paradigm shift described by Thomas Kuhn (Kuhn & Hacking, 2012).

Bracketing our advanced knowledge of astronomy for a moment, from a naïve point of view it seems absolutely obvious that the sun revolves around the earth. I can see it rise and set and it seems to move in a kind of curve which is characteristic of one ball moving around another. It also seems equally obvious that the earth stands still. Otherwise, according to common sense, we would all be propelled away from the earth by centrifugal force like water on a spinning basketball. So when Copernicus proposed that the earth revolves around the sun and is spinning around its own axis his contemporaries understandably ridiculed him (Kuhn & Hacking, 2012). The disbelief Copernicus encountered is even more understandable considering that the geocentric model works fine in most everyday circumstances. It is a useful heuristic for many purposes, such as predicting where the sun is going to set or using the sun for navigation. The geocentric model ran into trouble, however, when, after careful observation, anomalies regarding the trajectories of planets were discovered (Kuhn & Hacking, 2012). A lot of tinkering within the existing paradigm could not explain these anomalies. Only when a new model, the heliocentric model, was proposed was the issue resolved. The two major insights by Copernicus, that the earth revolves around the sun and that the earth spins, are completely counterintuitive, yet they are able to predict many more phenomena than the geocentric worldview could and allowed for a different and much more accurate kind of astronomical investigation to develop (Kuhn & Hacking, 2012). It is worth pointing

out that the heliocentric worldview did replace the geocentric view in astronomy but that in everyday life we still mainly rely on the geocentric model because it is simple and provides a useful heuristic for everyday purposes such as using the sun for navigation (Wallace, 2007).

Considering the Copernican revolution, it seems that we are at a similar point regarding consciousness and its place in the universe (Russell, 2005). As I will argue throughout this essay it seems that our default ontology of realism, an entity we call self and dualism might be good heuristics for everyday purposes, and will likely continue to be so, it might not, however, withstand a more fine-grained and sophisticated direct investigation of consciousness. Moreover, our dearly held assumptions of our default ontology might actually *stand in the way* of such an investigation.

Kant famously proclaimed that we need a revolution in philosophy akin to the Copernican revolution in astronomy (Kant, Mohr, & Willascheck, 1998). This would involve rethinking the relation between knowing and the object known (Kant et al., 1998). Instead of assuming that our knowledge must conform to the world, Kant proposed that the world must conform to our knowledge (Kant et al., 1998). But in order to realise this, he said, we would need a revolution in thinking (Kant et al., 1998). I believe that we find ourselves amidst the very revolution Kant was talking about. This shift seems to be even more counterintuitive and fundamental than the Copernican revolution as it involves not our planet and its place in the universe but each one of us and our relation to the world (Russell, 2005). I will start the investigation of this shift by returning to the example of my momentary content of consciousness.

1.2 Beginning with certainties: there is experience

So where do we begin? The general direction of this essay is from ontology and epistemology towards methodology. In order to proceed systematically I will try to start from certainties and then build the subsequent discussion on this foundation. To do this I will start again with my momentary content of consciousness provided in the previous section. This content included my laptop, the room, the sun, bird song, feelings of hunger and thoughts about food and writing. We can now make my experience more specific by saying that in my visual awareness there is a laptop, my hands typing, my desk with parts illuminated by the sun's rays, and the part of my

room that I am facing. In my auditory awareness there is bird's song and the sound of the keys of my keyboard. In my awareness of other sensory modalities I pick up the warmth of the sun's rays, a visceral feeling of hunger and the sensation of my hands typing. In my mental, metacognitive awareness I find thoughts about food among some thoughts about writing.

So looking at my momentary content of consciousness, what can I be absolutely certain about and base our philosophical discussion on? I can be certain that *there is experience*. The category of experience might also be called content of consciousness, phenomena, information or qualia[3].

At this point I have to pause and clarify that the argument so far does not contain any claims about the nature or cause of these experiences, topics which will be discussed next. There has also not been a claim about a self in which these experiences take place. Furthermore, so far the argument is only concerned with a single subjective viewpoint which means that the problem of other minds does not feature in our momentary discussion. The only thing that has been claimed is that there is experience.

1.3 Experience and the cause of experience

Having established the existence of experience as certain we can now turn our focus towards theories about the cause of this experience. There are many models and theories regarding the cause of experience. For example, one person might say that the underlying cause is matter; another might argue that experience is caused by vibrations; a third might be convinced that we are plugged into the matrix and that our experiences are actually illusions created by a computer. The important point is that all of these theories are abstractions from experience, ways in which we try to make sense of our experience. So we can state, then, that *experience is primary and all theories and models regarding the cause of that experience are secondary* (and are experiences in themselves). No matter whether the underlying cause is matter, vibration or a computer deceiving us, the experience itself remains the same.

This focus on direct experience without regarding the causes or levels behind this experience has been called epoché in the tradition of phenomenology

[3] Qualia is a technical philosophical term for qualitative experiences, (e.g., the redness of a rose).

(Thompson & Zahavi, 2007). It can be understood as a bracketing of the world while focussing on direct experience. The process of focussing on the phenomena is also called the *phenomenological reduction* which is contrasted with the *natural attitude* mentioned before (Thompson & Zahavi, 2007).

In the example of my momentary content of consciousness I mentioned many different things, such as hands, computers, thoughts and feelings, concepts which are seemingly belonging to very different categories, such as mental and physical. The categorical distinction between mind and matter goes back a long way and Descartes famously called these categories *res extensa* – the extended thing – and *res cogitans* – the thinking thing – respectively (Descartes & Cottingham, 1996). However, many thinkers have opposed Cartesian dualism and stated that we can see the world in terms of a larger category underlying the notions of mental and physical. William James called this larger category *pure experience* (James, 1912). Ernst Mach had similar ideas and called the underlying category *Bewusstseinsinhalt* (content of consciousness) (Mach & Wolters, 2008). Husserl and the phenomenologists simply call it *phenomena* (Thompson & Zahavi, 2007) and many other terms have been proposed for this category such as *experience*, *datum* or simply *that* (James, 1912).

To clarify, for now I can assert that from my subjective point of view both my hand (body) as well as the room (external surroundings) as well as mental experiences (thoughts and feelings) are first of all qualitative experiences despite the different ways of apprehending them. According to this line of reasoning the categories of mental and physical can be seen as derivatives or parts of the underlying category of experience (James, 1912). In light of this fact James regarded anyone treating a supposed cause of experience, (e.g., matter), as more fundamental than actual experience to seemingly be under the “delusion of treating the *name* of a concrete phenomenal reality as an independent metaphysical entity, and placing it behind the reality as its explanation” (James, 1922, p. 220, his italics). The distinction between the primacy of experience and the secondary nature of supposed causes of experience is important because it might convince us to investigate experience itself in more detail in addition to studying supposed causes of experience such as matter.

1.4 Measurement and information

One useful way to look at experience is in terms of measurement. In analogy to scientific measurements we can conceptualise ourselves as a measurement apparatus and each of our experiences as a measurement. Our apparatus has six sensors and an additional sensor able to pick up mental events. Each sensor is sensitive to certain electromagnetic waves or certain chemical signals. Applying the language of measurement to ourselves and our experience will be useful in the later discussion on the possibility of applying the scientific method to the mind and refining or recalibrating our measurement devices.

I also want to introduce another way to frame experience, namely in terms of information. This category is broader than that of experience and also allows a more technical discussion of the topic[4]. There are many definitions of the term information. I will use it in the way Gregory Bateson framed it, namely as “a difference that makes a difference” (Bateson, 1972). This definition can be unpacked using the example of the very text you are reading. This essay consists of a white page with letters on it. Without the letters the white page would simply be undifferentiated and could not be said to contain any information. For the difference between page and text to exist it is necessary that the colour of the writing is different from the colour of the page. Were they exactly the same there would be no information. This first difference of black letters on a white page, however, is not enough. For information to exist there needs to be a system which is informed, a system in which the difference between letters and white page can *make a difference*.

Without this informing of a system no information can be said to exist. Therefore, rather than saying there is information one could say that information happens or takes place. This means that we can see *information as process or interaction*. The very term “information” might be misleading because it makes information into a noun, a substance, an entity. Informing might be a better term to emphasise the process nature of information. One might then ask what it is that is being informed which leads us to the next topic: consciousness.

[4] Information is also the basis of one of the most promising theories of consciousness, integrated information theory (Tononi, 2012).

1.5 Consciousness as capacity for experience

So far I have been talking about content of consciousness but have not yet defined what I mean by consciousness. Defining consciousness seems especially important when considering that there are literally dozens of sensible definitions of it and that therefore different people mean very different things when they use the term. The definition for consciousness I will work with in this essay is *capacity for experience* (Russell, 2005). One might also frame it as a *potential for being informed*. This concept of consciousness has also been called awareness, sentience, phenomenal consciousness[5] and simply subjectivity (Blackmore, 2010). However, I prefer "capacity for experience" or "potential for being informed" because these terms go against our tendency to conceptualise consciousness as an entity. This tendency brings us right to the core of the difficulties we encounter when thinking about consciousness.

When thinking or talking about consciousness we cannot help but reify consciousness, making it into a thing, an entity. The reification of consciousness is a prime example of what Alfred North Whitehead called the "fallacy of misplaced concreteness", seeing something as a thing when it is not (Whitehead, Griffin, & Sherburne, 1979). Similarly, William James regarded consciousness to be a "nonentity" and stated that it "has no right to a place among first principles" (James, 1922, p. 2). In information terms, *consciousness is not a difference but that in which a difference can be made*. The problem is that language which necessarily uses relatives is not apt for describing consciousness (cf. section "The process of reification).

So while consciousness is not an entity we still have to conceptualise it in some way if we want to talk about it. I will provide three analogies which might make the concept of "consciousness as potential" easier to grasp.

First, one quite intuitive way to think about the idea of consciousness as potential is that every day each one of us has a certain potential for experience. The content might differ from day to day and from person to person but the potential, the capacity for experience, remains the same every day and for every person (Russell, 2005). Furthermore, without this potential of a new day no content could appear.

[5] For a discussion of the difference between phenomenal and access consciousness see (Block, 1995)

Second, we can return to the example mentioned in the earlier discussion of information and see consciousness and its content as somewhat analogous to the relationship between figure and ground. We can illustrate it using this essay. There is black writing on a white page. In this analogy the white page represents consciousness and the writing represents content. The page is the potential for being informed by the writing. Without the page, again, no content could appear.

Third, we can use the analogy of space and matter. Without space there would be no way to define matter in terms of edges or the relationship between different pieces of matter. So space is a necessary prerequisite for matter to appear.

We can also use these examples to illustrate the fallacy of misplaced concreteness and maybe understand better why it is so hard to think about consciousness. It seems that we often try to approach consciousness in terms of content of consciousness. Taking one of the examples this would mean attempting to describe the white page in terms of the writing on the page which, of course, is doomed to fail. Similarly, the attempt of defining consciousness in terms of content of consciousness is equally futile. It is worth pointing out that I do not make any claims regarding the origin or location of consciousness but simply state that there is a potential for experience and that this potential is necessary for the arising of content.

There is one last point which has to be made regarding the analogies used earlier. One telling shortcoming of the analogy about the page and the writing is that in terms of perception the component analogous to consciousness, the white page, cannot only be seen as potential for content but also be experienced as content itself. This is not true for consciousness as it does not feature as content. Consciousness is not a thing but that which makes thing-ness possible.

1.6 The plasticity of experience

Having established the necessary ingredients for experience to appear – information and a potential for being informed – this section is concerned with the kind of access we have to the world and factors influencing that which appears to us. I will proceed using a number of examples, analogies and experiments which will implicitly explore our metaphysical and naïve realist tendencies. The main goal of this discussion is to prepare the reader for the counterintuitive ontological and epistemological conclusions which will be presented afterwards.

1.6.1 Noumenon and phenomenon

We can start this part of the discussion with an important distinction made by Immanuel Kant. Regarding our access to the world Kant distinguished between the *noumenon* – the thing-in-itself – and the *phenomenon* – the way things appear (Kant et al., 1998). He went on to say that we can never know the noumenon but are only ever able to access the phenomenon (Kant et al., 1998). An ancient image which can help us grasp this notion better and will enable us to make some additional points is the image of the blind men and an elephant (see Figure 1). In this image six blind men are asked to investigate an elephant with their hands and to report what kind of a thing an elephant is. Each one of the men is investigating a different part of the elephant and accordingly gives a different account of it.

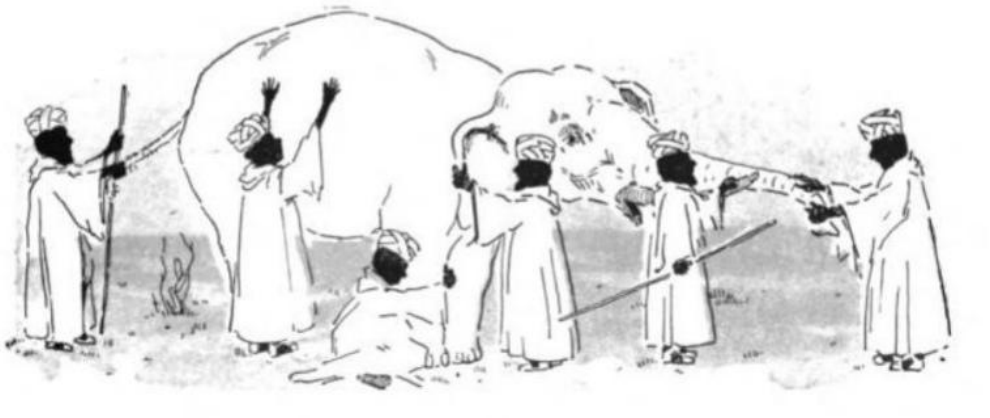

Figure 1: The blind men and an elephant (Stebbins, Martini, & Coolidge, 1909, p. 89)

The first, having felt the stomach of the elephant, reports that an elephant is like a wall. The second says that an elephant is like some kind of pillar after having investigated a leg. The other four men, having explored an ear, the trunk, a tusk and the tail of the elephant report that an elephant is like a thick flag, a kind of hose, a pointy spear or a kind of rope.

We can see that the information generated in the interaction of each of the men with the elephant arose in relation to the kind of access they had to the elephant, the respective body part they were exploring. So while each of the men is giving a somewhat correct account of the elephant none of them is able to give a complete account. And it seems like no one ever could give such a complete account since each different perspective on the elephant can potentially unravel new information about the elephant. A man able to see might add to the reports of the

blind men that the elephant is grey. A biologist might add that it is an animal living in herds. A physicist might add that it has a certain weight and certain electromagnetic properties. A psychologist in turn might add that elephants are able to recognise themselves in the mirror. Each of these accounts is based on a certain measurement. All perspectives can access a certain *phenomenon* of the elephant but none are able to experience the elephant as a *noumenon*.

In line with the image of the blind men and an elephant one way of looking at the universe would be to see it as many parallel universes, or a multiverse, with each universe enacted according to the perceptual abilities of a different measuring device (Varela, Thompson, & Rosch, 1991). We can take the elephant as an analogy of the world at large. The only inaccuracy of the analogy might be that in the example of the elephant there seems to be the pre-packaged, pre-given entity of the elephant. Each one of the men is then describing one aspect of the pre-existing elephant. Concerning the world at large, as will become clearer as the discussion proceeds, we do not seem to have access to such a pre-packaged, pre-given entity; instead the world seems to emerge in the process of information, in the process of measurement (cf. sections “The measurement ontology” and “Bringing forth a world”). It seems that nothing sensible can be said about the elephant prior to and apart from our measurements and our perceptual frameworks. This brings us to our next point: embodiment and perceptual abilities.

1.6.2 Embodiment and perceptual abilities

So it seems we can never access or measure the noumenon but are restricted to measuring phenomena. I will now look at factors which influence what kind of phenomena appear to our measurement system. One factor which influences the kind of phenomena which appear to us or arguably makes this appearance possible at all is our body and the perceptual abilities that come with it. Returning to the example of my experience of the sun’s light we can hold that the visual information of the light appearing to my system depends on my body, especially my eyes and nervous system. Systems with different perceptual abilities will have access to different phenomena. The honey bee for example is able to perceive ultraviolet light and we have to suppose that its perception of the sun’s light differs accordingly.

Because of human's limited visual perceptual abilities, ultraviolet light will never feature in human experience. We can use instruments in order to translate ultraviolet light into a manifestation within the bounds of our visual spectrum but we can never actually visually perceive the ultraviolet light itself. This also means that we will probably never know what the world looks like through a bee's eyes (Nagel, 1974). Of course, in another way ultraviolet light is informing even a human system demonstrated by the fact that our skin darkens when exposed to ultraviolet light. But as visual information it does not feature in human experience. The kind of measurement sensors we have constrain the kind of measurements we can make. Following this discussion we can acknowledge that *what manifests as our experience depends on our perceptual abilities, on our kind of embodiment*.

1.6.3 Intellectual epistemic pluralism

Our access to information also depends on our intellectual capacities. This essay for example does not provide the same information for every measurement system. A system with the same basic perceptual abilities but with different intellectual abilities will be informed differently. Viewing this essay from the perspective of a baby the information contained in this essay might be reduced to something that makes a crumbling sound when I touch it with my hands or to something which does not taste very good when I put it in my mouth. For a small child not yet able to read the information might be reduced to black lines on a white piece of paper.

Actually, the term "reduced" might not be the best choice of words in this context. It would be more accurate to say that it is simply *different* information which appears to different systems. It is true that certain information cannot be accessed without command of the English language and the ability to read, however, it might also be possible that our focus on the complex meaning of a text obscures some less complex level of information the illiterate child can access. My ability to understand German, for example, prohibits me from accessing other informational layers. One layer I cannot access is the pure sound of German speech without simultaneously being exposed to the meaning of the words. The important point is that all information has the same ontological validity; different systems are simply informed in different ways. So we can assert that *what manifests as our experience also depends on our intellectual abilities.* A question which arises is whether we can

change what appears as our experience by gaining a better intellectual understanding of the way experience or the mind works (cf. section “Bringing forth a world”).

1.6.4 Intrapersonal epistemic pluralism and the importance of preceding measurements

The effect different measurement capacities have on experience cannot only be shown regarding different systems, different persons or species, but can also be demonstrated within one and the same system. Different measurements can produce conflicting information within oneself. We can easily grasp the reality of this by conducting a simple experiment suggested by John Locke (1836).

Take three buckets and fill them with water, one with hot, one with cold, and one with medium-temperature water. Place the buckets on a table with the one containing the medium-temperature water in the middle. Now place one hand in the bucket containing cold water and one in the bucket containing hot water and keep them there for thirty seconds. Then put them both at the same time in the bucket containing the medium-temperature water. The result of this is that for a second or two the water in the middle bucket feels both cold and hot at the same time – cold to one hand and hot to the other. The same water informs our measurement system differently. We might call this effect *intrapersonal epistemic pluralism*. The question what the water in the middle bucket is *really* like might begin to sound silly.

The example of the three buckets also shows that the qualitative character of our measurements depend on our preceding measurements. Depending on the previous sensations the water seems hot or cold. This goes to show that *our measurements can only be made sense of considering other measurements* (cf. section “Quantum mechanics”).

1.6.5 Introspection and interoception

So far I have mentioned that the information which manifests as our experience depends on our perceptual abilities regarding external stimuli. The same is also true for our perceptual abilities for stimuli coming from within. The two aspects I will talk about in this context are introspection and interoception. *Introspection* refers to our ability to observe inner phenomena. Depending on one’s definition this includes thoughts, emotions and feelings. Introspective abilities have been shown to vary between persons (Lutz, Slagter, Dunne, & Davidson, 2008). *Interoception* has

been defined as the process of receiving, accessing and appraising internal bodily signals (N. Farb et al., 2015). An example of such a signal is the heartbeat and a heartbeat perception task is often used to assess interoceptive accuracy (Bornemann & Singer, 2017). Interoceptive abilities also differ between individuals (Bornemann, Kok, Böckler, & Singer, 2016; Bornemann & Singer, 2017). Differences in introspective and interoceptive awareness affect how well we are able to access inner stimuli. An example of a deficit in these areas is alexithymia which describes a condition with deficits in emotional awareness (Sifneos, 1973) including difficulties in identifying and describing one's emotions (Bagby, Parker, & Taylor, 1994). Although we all have a heartbeat and emotions we may not all have equal access to them. So we can state that *what manifests as our experience also depends on our introspective and interoceptive abilities*. Again, the question arises whether we can change or refine the information that appears as our experiences by training these abilities.

1.6.6 The influence of expectation on experience

Our experience is also influenced by our expectations regarding that experience. A good example of this is the placebo effect (de Craen, Kaptchuk, Tijssen, & Kleijnen, 1999). Placebo means "I shall please" in Latin and it is used to describe the effect that a person's positive belief can have on an outcome. New medication, for example, has to be compared to a control group receiving a placebo, in most cases a sugar pill, to test whether the new medication has an effect above and beyond the expectation of an effect. How powerful the placebo effect is can be seen in a study that compared real surgery to sham surgery (Moseley et al., 2002). Moseley and colleagues divided a group of patients in need of knee surgery in two groups and performed the surgery in one group but in the other just convincingly pretended to have performed the surgery. They found that after two years the patients in the treatment group were not reporting less pain or function than the patients in the control group who only believed that they had had the surgery (Moseley et al., 2002).

The effect of expectations on our experiences can also be shown under very controlled conditions in the lab. One study adequately called 'believing is seeing', found a dramatic effect of experimentally induced expectations on the perception of an ambiguous visual motion stimulus (Sterzer, Frith, & Petrovic, 2008). The same

stimulus was presented but was interpreted and thus seen differently solely because of different induced expectations. So we can state that *what manifests as our experience is influenced by our expectations*. And again the question arises whether we could not only become more aware of our expectations but change them and thus have an influence on what appears as our experience[6].

1.6.7 The importance of attention

Another factor which has an influence on our experience is attention. William James wrote on attention: “My experience is what I agree to attend to. Only those items which I notice shape my mind - without selective interest experience is an utter chaos. Interest alone gives accent and emphasis, light and shade, background and foreground - intelligible perspective, in a word" (James, 1891 p. 402). We can comprehend what James means using the example of my momentary content of consciousness discussed earlier. Regarding this content I can focus my attention on the room, the monitor, my hand, my feeling or thought about hunger and my momentary experience will differ accordingly. Furthermore, I can imagine a truly infinite amount of things. Another example we can use is *your* momentary content of consciousness regarding this essay; you can focus your attention on a single letter, a word, the whole sentence, the font style, the white background or the meaning of the words. *What features as one’s experience thus has a lot to do with the focus of one’s attention.*

Another image which can be used to make additional points regarding the characteristics of attention and its importance for our momentary phenomenal experience is shown in Figure 2. This image is commonly known as Rubin’s vase; it is a so-called ambiguous or bi-stable figure. People usually report seeing the image as a vase or two faces. An interesting aspect of this image is that whether we see it as a vase or faces depends on our chosen focus of attention. We can on command switch back and forth between seeing it as a vase or faces. In simple terms one might say that the stimulus does not change yet our perception of it does. But this view is somewhat fallacious as we have seen before and will see in more detail later. It is ascribing some characteristic to the image prior to and independent of

[6] Predictive coding models of the brain also place great emphasis on expectations. They propose that the brain is continuously generating and updating hypotheses which predict sensory input and try to reduce the amount of prediction error (cf. Friston, 2010; Ondobaka, Kilner, & Friston, 2017).

measurement. A more correct description would be to say that two different processes of informing take place according to the characteristics of the respective measurement process.

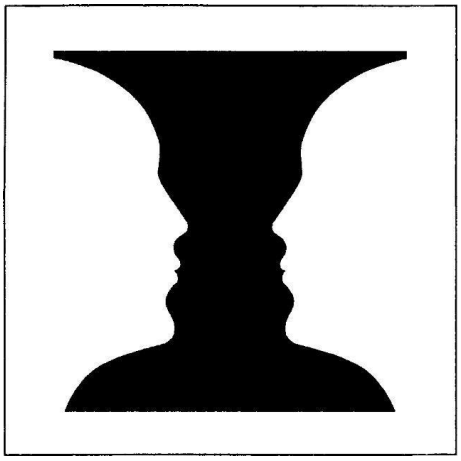

Figure 2: Rubin's vase (retrieved from https://www.pinterest.com/pin/107382772335670183/)

In the example of the elephant it was the different perceptual abilities of different measurement systems which were responsible for the creation of different information. In this case, however, it is the internal focus of attention which is responsible. And again, just like nothing meaningful could be said about the elephant prior to measurement the same holds true for this image. There is no intrinsic vase-ness or face-ness inherent in the picture but it instead comes into existence in the process of information, in the process of measurement.

Furthermore, echoing the previous discussion of embodiment, the image only contains the information of a vase or a face when considering not only the makeup of our nervous system, our eyes in particular, but also our cultural heritage containing vases and faces. The momentary appearance of an image thus depends on many factors and we cannot make sense of the image when taking away any of the factors contributing to the appearance of the image.

In our interaction with Rubin's vase we were able to control our attention quite well and could on command switch between either Gestalt. The enthusiasm about the voluntary control over attention and thus the control over what manifests as our experiences has to be firmly put back in its place, however. The process of attention

is not always as voluntary as the previous example might have suggested. This can be shown using another little experiment which I encourage you to try.

For this experiment sit comfortably, close your eyes and focus your attention on the sensations of your breath at the entrance of your nostrils. Do not think about the sensations but feel them. Keep your attention on these sensations for one minute. When you notice that your attention is not on its designated target, gently bring it back to the sensations of the breath. No, don't keep reading! Set an alarm for one minute and do the experiment! It is only a minute after all!

After having completed this experiment most people report that they were not able to keep their attention on the designated target but instead noticed after a short while that their attention had wandered from breath-related sensations to other mental events such as thoughts or emotions. So attention seems to be both voluntary and involuntary[7]. A more thorough discussion of this simple exercise will follow in part two along with the question whether we can gain more voluntary control over our attention.

1.7 The process of reification

To summarise, we have established that what manifests as our experience has a lot to do with our perceptual and intellectual abilities, with our expectation, our preceding measurements and our attention. I will introduce one last concept which is very useful for thinking about experience: the concept of reification. To understand the process of reification we will once again turn to William James.

James coined the term "stream of consciousness" which he said consists of pure experience (James, 1912) (cf. section "Experience and the cause of experience"). According to James, pure experience in its purest form is not yet distinct into categories but appears as the "immediate flux of life". He writes that only "new-born babes or men in semi-coma… may be assumed to have an experience pure in the literal sense of a *that* which is not yet any definite *what"* (James, 1912, p. 93, his emphasis). For most people the immediate flux quickly fills itself with "emphases, and these salient parts become identified and fixed and abstracted; so that experience now flows as if shot through with adjectives and nouns and prepositions and conjunctions" (James, 1912, p. 94). What he describes is our strong

[7] Another aspect of bistable figures is that attention in some cases oscillates between the two shapes (cf. Wang, Arteaga, & He, 2013).

tendency to abstract, analyse and categorise experience. This process usually happens so quickly that we are mostly unaware of it.

This is a very good description of reification. This reification takes the immediate stream of experience and turns it into things, discrete units of experience. Similar to the natural attitude discussed above the process of reification is so ingrained that we usually do not notice it. Reification could be translated as “making things”. But what exactly do we mean when we talk about a “thing”? Alan Watts poignantly stated that “a thing is a think, a unit of thought” and that a thing is “as much reality as you can catch hold of in one idea”(Watts, 1963). The etymological similarities between the words for thing and thinking are striking: English – thing and thinking, German – Ding and denken, Latin – res and reire. In line with Watts’ thinking *we can see a thing as a unit of mental measurement*.

We can illustrate the process of reification and some of its mechanisms using the image of a Rorschach inkblot displayed in Figure 3. Please take a moment to look at the inkblot and think about what it depicts.

Figure 3: An example of a Rorschach inkblot (Rorschach, 1921, retrieved from https://de.wikipedia.org/wiki/Rorschachtest#/media/File:Rorschach1.jpg)

These inkblots were used by early psychoanalysts as a psychodiagnostic tool. They showed them to patients and asked them to report what they saw. In doing so

the psychoanalysts were not interested in an accurate description of the Gestalt of the inkblot but were rather interested in finding out what the patients projected onto the inkblot, what patterns they were likely to see, what predispositions they brought *to* the inkblot. When asked what one sees in the inkblot one quickly turns the simple *that* of the rather random image of the inkblot into a *what* of a particular thing one sees in it.

Alan Watts suggests that we can liken the entire world to a giant Rorschach inkblot (Watts, 1963). In other words, we can see the world as consisting of some indefinable, random pattern on which we project categories, distinctions and values. Again, I have to point out that regarding the world at large, there does not seem to be any – however indefinable – pattern we can access prior to measurement.

1.8 Questioning the notion of a reified self

The process of reification leads us to the second instance after consciousness in which our common tendency to reify might cause some problems – the notion of self. Since there are many different notions of self (see Kyselo, 2014) I have to specify which notion I am discussing. The kind of self discussed in the following is the notion of an immutable, unitary and independent self, a self in terms of substance or entity (Wallace, 2007).

This notion of self has received much criticism in the past. One of the earliest and most radical criticisms of this notion of self has been expressed within the Buddhist tradition. In Buddhism, the concept of selflessness (*annata*) which argues against the notion of the self as entity is one of the tradition's most fundamental doctrines (Humphreys, 2012). *Annata* is "the doctrine of non-self, and is an extreme empiricist doctrine that holds that the notion of an unchanging permanent self is a fiction and has no reality." (Humphreys, 2012, p. 51).

Buddhism's criticism of the self as an entity has been paralleled in the West. Examples of Western thinkers criticising this notion of self are David Hume and William James. Hume famously proclaimed that when looking inside himself he is never able to catch himself but only encounters perceptions of some sort or another (Hume, 1739, section VI, as quoted in Blackmore, 2010, p. 107). James also rejected the notion of a fixed, independent self rebelling especially against the Kantian transcendental ego, calling it only a "cheap and nasty edition of the soul" (James, 1891, p. 365). James denied the existence of a separate self and instead

concluded that "thought is itself the thinker" (James, 1891, p. 401). He argued that there is always a passing thought which is based on previous thoughts. In any given moment the present thought appropriates some of the previous thought content as mine while disowning others (James, 1891). As a consequence a sense of self based on the appropriated thoughts is created (James, 1891).

James' notion is echoed in the more recent approach of enactivism (Kyselo, 2014) which sees the self as "a process of I-ing - an on-going process that enacts an "I" and in which the "I" is no different from this process itself" (Thompson, 2014, p. 326). Similar to James, Thompson (2014) describes the process of I-ing as a self-designating process. Furthermore, this process of I-ing and the kind of I that is created in the process seems to be very different in different states of consciousness, (e.g., waking or dreaming) (Thompson, 2014). A belief in the notion of self in terms of an entity can be seen as another example of Whitehead's fallacy of misplaced concreteness – making an entity out of something which is not (Whitehead, 2004).

Another strand questioning the notion of a reified self is modern neuroscience. There are many neuroscientific studies about the self. One example is a study exploring self-reference which concluded that there seem to be partially different neural structures involved depending on different modes of self-reference, (e.g., narrative focus or experiential focus) (N. A. S. Farb et al., 2007). While there are certain correlates underlying aspects like our self reference, there does not seem to be one place in the brain where the self sits, one brain area where it all comes together (Metzinger, 2009). This lack of a physical location has led Thomas Metzinger to assume that "[n]obody ever was or had a self" (Metzinger, 2003, p. 1).

In light of these criticisms, while it may be very intuitive to see ourselves as an immutable, unitary and independent entity, close analysis seems to reject this view. Instead the self might more accurately be seen as an on-going process of self-designation which produces a self in the very moment. This self can differ substantially depending on one's state of consciousness.

1.9 The measurement ontology

The previous discussion of our default ontology, of the concepts of information and measurement and of the factors influencing what manifests as reality was mainly aimed at understanding intuitively what I will now discuss more technically. Having

thoroughly undermined our notions of realism and a reified self I will present a worldview which radically differs from our default ontological assumptions and which also questions our notion of dualism. This worldview has been expressed in many different ways and has been given many different names. Because of its emphasis on momentary instances of interaction I refer to it as *measurement ontology*. I have already hinted at this view when discussing information and the factors influencing experience. This worldview stresses process and interaction rather than substance or entities. It also characterises reality as interdependent and necessarily embodied. This view will form the basis for the discussion that follows in part two. To give a rich account of this view I will look at three different versions of it coming from very different lines of thought: Western philosophy, modern physics and Eastern philosophy. Each of these systems of thought investigates our default ontological assumptions of metaphysical realism, a reified self and dualism in a thorough and systematic way. The theories I will discuss are Whitehead's process philosophy (he called it the "philosophy of organism"), the von Neumann-Wigner interpretation of quantum mechanics and the notion of *advaya* of the Buddhist Yogācāra school. It is worth pointing out that similar ideas have been expressed in other traditions, especially in the Eastern traditions of Daoism (Creel, 1970) and Advaita Vedanta (King, 1995).

1.9.1 Whitehead's process philosophy

Alfred North Whitehead argues that not substance but process is the most fundamental principle of the universe. His ontology is based on what he calls *actual entities* which according to him are the entities of which the world is made up (Johnson & Whitehead, 1962). These actual entities are seen as atomic *actual occasions* brought into existence by interaction (Epperson, 2004). According to this view the universe can be seen as a chain of these *actual occasions* which are influenced and in turn influence but not fully determine following *actual occasions* (Epperson, 2004). Whitehead argues explicitly against the "bifurcation of nature" of Cartesian dualism which sees mind and matter as different categories. He rather states that each atomic occasion has a mental and a material pole and describes them as interrelated modes of reality but not separate substances, one being more fundamental than the other (Epperson, 2004). As we have already discovered he takes a strong position against the reification of matter or consciousness and states

that proponents of either view engage in the fallacy of misplaced concreteness (Whitehead, 2004). Whitehead's views are very similar to ideas expressed in quantum mechanics and according to some were inspired by the recent advent of this new theory in physics (Epperson, 2004).

1.9.2 Quantum mechanics

Quantum theory is one of the most-tested and accurate yet also one of the most perplexing theories there are. A quote attributed to Niels Bohr illustrates this: he supposedly said that "if you think you understand quantum mechanics, you do not understand quantum mechanics". Quantum mechanics (QM) is a field of physics concerned with the realm of the microscopic. When describing events at the microscopic scale certain phenomena appear which seem to contradict everything we believe to be true about the universe. Quantum phenomena such as entanglement, non-locality or the uncertainty principle defy our common sense (Greene, 2003). It is obviously beyond the scope of this essay to give a complete account of QM, so I will focus on the aspects relevant for the discussion at hand; in particular the way in which measurement is conceptualised in the scheme of QM.

One of the most striking features of QM is known as the "wave-particle duality". The results of certain experimental setups can only be explained when conceptualising a photon as a wave; other experimental results require one to see it as a particle. In other words, in some instances a photon behaves like a particle and in some instances it behaves like a wave (Greene, 2003). This – of course – is extremely troubling to common sense and especially to the common sense of a scientist trying to understand the basic principles of nature. A certain phenomenon, in this case light, cannot be both a particle *and* a wave; it has to be one *or* the other.

The amount to which QM asks us to reconsider our default ontology regarding realism becomes clear when considering the results of a recent so-called "quantum erasure experiment". The experimental setup is quite intricate and involves two entangled particles and the experimenter being able to "actively choose whether or not to erase which-path information, a particle feature, of one quantum system and thus observe its wave feature via interference or not by performing a suitable measurement on a distant quantum system entangled with it" (Ma et al., 2013, p. 1221). In their conclusion the authors write: "No naive realistic picture is compatible with our results because whether a quantum could be seen as showing particle- or

wave-like behavior would depend on a causally disconnected choice. It is therefore suggestive to abandon such pictures altogether." (Ma et al., 2013, p. 1221). This means that whether a quantum displays particle- or wave-like characteristics depends on one's experimental setup.

In QM a "phenomenon is *codefined* by the experimental conditions of its manifestation" (Bitbol & Petitmengin, 2016, p. 62, their italics). The phenomenon is "taken as inseparable of its experimental context." (Bitbol & Petitmengin, 2016, p. 62). Furthermore, QM describes the probability of observing a certain particle at a certain point in space-time. Before and apart from observation, however, it does not make any sense to speak about the particle as such (Greene, 2003). In the context of QM, measurement can no longer be seen in categories of measuring some independent material substance but rather has to be seen as a relational structure (Dürr & Oesterreicher-Mollwo, 2004).

This interactive nature of the QM measurement process has led physicist John Archibald Wheeler to propose that not matter but information may lie at the ground of physics as well as our reality (Wheeler et al., 1998). This is exemplified by his famous saying of "it from bit", meaning that matter is derived from information. He writes that "that which we call reality arises in the last analysis from the posing of yes–no questions and the registering of equipment-evoked responses; in short, that all things physical are information-theoretic in origin and that this is a *participatory universe*." (Wheeler, 1990, p. 5, his italics). Werner Heisenberg, an important figure in the early days of QM, known for his formulation of the uncertainty principle, wrote in a similar vein: "What we observe is not nature in itself, but nature exposed to our methods of questioning." (Heisenberg, 2007, p. 58). He further stated that "[a]toms and the elementary particles themselves are not real; they form a world of potentialities or possibilities rather than one of things or facts" (Heisenberg, 2007, as quoted in Wallace, 2003, p. 274).

This statement goes to the heart of the implications of QM. In the aftermath of the discoveries made within the scheme of QM the term reality (coming from res – thing) might have to be replaced with the term potentiality (Dürr & Oesterreicher-Mollwo, 2004). The question of what exists is replaced by the question of what happens; the world of QM is characterised by terms such as *process, interdependence, becoming or potentiality* (Dürr & Oesterreicher-Mollwo, 2004, my italics). This is hard to grasp for our mental schemes which have evolved to see

things in forms of matter and discrete entities (Dürr & Oesterreicher-Mollwo, 2004). Even the founders of quantum mechanics, Einstein and Planck, were not comfortable with the far-reaching philosophical implications of QM (Dürr & Oesterreicher-Mollwo, 2004).

In the scheme of QM that *which is measured* cannot be viewed in isolation from that *which is measuring* or by extension from *what is not measured* – the environment (Epperson, 2004, my italics). The measurement system and that which is measured are necessarily interrelated facts (Epperson, 2004). John von Neumann stated that the classical conception of subject of measurement and object of measurement "become properly understood as arbitrary abstraction from a more fundamental quantum mechanical characterization of measurement as the correlation of serially ordered quantum actualizations. Every particular subject-object correlation, then, becomes a datum for a subsequent subject-object correlation" (cited in Epperson, 2004, p. 39).

While representing something of a simplification, one way of making this idea more graspable is to look again at the three bucket example mentioned earlier. The two serial measurements performed by the same hand are necessarily interrelated facts. The second measurement of the quality of the water temperature as hot or cold, respectively, would not be possible without reference to the preceding measurement. Furthermore, in light of the two measurements of different hands, asking about the *actual* temperature now seems to lose all meaning.

1.9.3 The Yogācāra school of Buddhism

The philosophical insights described in the examples of Whitehead's process ontology and the ontological framework underlying quantum mechanics has a parallel in the Buddhist tradition which expressed very similar ideas. The reason I mention this is to show that these insights are not particularly new and Buddhism has framed these insights in a very accessible way. When looking again at my awareness of the sun, there seems to be a subject, me, and an object, the sun. Similar to Whitehead, the Yogācāra school holds that the sun is not really an independent object perceived by an independent subject but that one moment of awareness has two sides or aspects – the aspect of the outer-seeming aspect of the sun – and the inner-seeming aspect of the visual awareness (Thompson, 2014). They hold our distorted view of a permanent self responsible for making it seem like

it is “my” awareness of a separated object – the sun. In this way a subject-object structure is projected onto awareness (Thompson, 2014). They state that the grasping (*grahaka*, "cognition") and the grasped (*gradya*, "cognitum") do not exist separately (King, 1995). In other words, cognition and the object being cognised are not two. These two interrelated aspects of sun and visual awareness are reified from the actual phenomenal event. This process of reification of self and world is seen as a cognitive distortion (Thompson, 2014).

1.10 Bringing forth a world

To summarise the points made in the previous discussion: we do not have access to the thing-in-itself but only to the way things appear to us. Our experience depends on our embodiment and perceptual abilities, on our intellectual abilities, on our introspective and interoceptive abilities, on our expectations, on our previous measurement and on our attentional focus. Influenced by these factors a world appears in accordance with our measurement apparatus. Our ontology based on substance and entities might have to be replaced with an ontology which focuses on potential, interaction and process.

It seems that there is no world out there or a self in here but that both co-define each other and are brought forth in the very moment, one measurement at a time. Expressed in enactivist terms, there does not seem to be a pre-given world represented in a pre-given mind but rather “the enactment of a world and a mind on the basis of a history of the variety of action that a being in the world performs” (Varela et al., 1991, p. 9). Therefore, there also does not seem to be one right way of seeing the world, one true, “real” reality, but rather different ways of measuring and being in the world.

I believe that this is exactly the kind of revolution in thinking that Kant had in mind. If the measurements we choose to make have such an impact on what manifests as reality we can more clearly postulate that indeed the world must conform to our knowledge rather than the other way around. Some might thus claim that we *create* our own reality but I think that this is not correct. A better way to put it might be that we *co-create* reality. Co-creation in this context means that we have some influence over the process of creation but that there are also other contributing factors not under our immediate control. We have seen in the example of the Copernican revolution that for most everyday purposes the geocentric model still

works sufficiently well and we still rely on it. We need the heliocentric model, however, for a deep and fine-grained analysis of celestial phenomena. Similarly, the notion of a world and self in terms of entities is likely to still be used for everyday purposes. However, the view of a process-based measurement ontology might allow for a much more detailed, sophisticated investigation of consciousness. This will become clearer in part two of this essay.

The previous discussion of ontology also points to what Wheeler called “the participatory universe”. We do not seem to be passive observers of a pre-existing universe but are rather active participants in an emerging world. We are involved in the co-creation of a world whether we want to or not and whether we are consciously aware of it or not. The realisation that we are active participants can instil in us a sense of empowerment but also a sense of responsibility. I might feel empowered because I may be able to gain more control over my part in the co-creative process of bringing forth a world. If a world is brought forth with my contribution, however, I also have a responsibility for the kind of world I help create.

What follows from the previous discussion? How does it change not only our ontology and epistemology but also our methodology? In other words, what are the implications of this worldview for our scientific and philosophical practice? There are a number of answers to these questions which I will explore in the remaining part of the essay.

2 Implications for science and philosophy – applying the scientific method directly to the mind

2.1 Introduction

When we conceptualise the world as a chain of measurements it might be rewarding to take a long and deep look at the measurements we are performing on a daily basis and the kinds of worlds we bring forth accordingly. In addition to studying the world we have to investigate what we bring *to* the world.

The gist of the argument of this part of the essay is that as a consequence of the previous discussion we should establish an inner science which looks at ourselves in terms of a measurement apparatus and the stream of consciousness a stream of measurements which can be the target of scientific investigation. In other words, we should apply the scientific method directly to the mind. Importantly, to do

so we might have to enhance our measurement abilities by refining our mental faculties. If we could train attention and introspection we would not only enhance our understanding about the measurements we are making but we might also gain greater control over them.

Moreover, since the self also seems to be created and continuously updated in the on-going process of measurement, how we perceive ourselves also seems to have a lot to do with our ways of measuring. The narratives which we use to describe ourselves are based on past experience which determines how we experience ourselves in the future which in turn leads to new experiences etc. This process has been well-captured by Ian Hacking's "looping effect" which says that we tend to create a category, treat it as real and then reconceptualise ourselves in terms of that category (Hacking, 1999). A deep analysis of our own measurements and the process of self-designation might enable us to make even this fundamental process more visible and accessible. We might even discover – as Thomas Metzinger suggests – that it may be possible to experientially overcome the subject-object distinction altogether (Metzinger, 2009).

But before going into the topic of applying the scientific method directly to the mind we have to take a short look at science in general and the kind of data science has access to.

2.2 Scientific access – from objectivity to intersubjectivity

2.2.1 Objectivity and intersubjectivity

One distinction in the context of information and measurement is the one between information which is privately observable and information which is publicly observable. Usually these two categories are referred to as "subjective" and "objective". There seems to be information which only I can access[8] and information which can be accessed from more than one viewpoint, so-called objective information. Or at least that is the way it seems. Let's look at a concrete example.

Let's say you and I are sitting at a table. We can both see and touch the table. We can both say that it is brown and that it feels hard. We both seem to have access to the same table which is out there in the real world, an objective table. At this point of the essay, and when again thinking in terms of information, it should be obvious

[8] This discussion is concerned with *experiential* access not with *epistemic* access. For a discussion of these two kinds of access see (Pauen, 2010).

that this kind of thinking is problematic. We already established that information can only come about in dependence on a system which is being informed. So in the case of the table *your* system is being informed and *my* system is being informed. The information each of us brings forth is not identical. Regarding visual information you might be able to see the edge of the table pointing in your direction which I am unable to see. I cannot access this information. But because our measurement devices and thus our measurements are very similar we agree for example that the table appears to be brown. Intersubjective agreement, however, does not mean objective truth. The only thing I am prepared to say with certainty is that there is the *appearance* of a table. Any claim regarding an objective world behind this appearance is based on speculation. Extraordinary claims need extraordinary evidence and providing evidence for an objective, mind-independent reality existing apart from our frames of references is in principle impossible. The argument I am making is not an ontological argument trying to prove that there is no external reality. It is rather an epistemological argument that we can never know or access this kind of reality (cf. section “Noumenon and phenomenon”).

2.2.2 All scientific data are ultimately (inter-)subjective data

If we translate this example into the context of science we might ask what kind of observations science has at its disposal or what kind of scientific data there are. The previous discussion of the factors influencing experience and the measurement ontology was meant to prime the reader for the discussion which we get into now. The starting point of it is that all the information we have at our disposal are equipment-evoked responses coming about in accordance to some measurement system, to some subjective viewpoint. There is no view from nowhere, no God’s eye view we can access. Wallace (2007) succinctly states that “[i]n the final analysis, all scientific observations boil down to multiple individuals' firsthand experiences, and when those experiences are similar – or *intersubjective* – they are regarded as third-person scientific observations” (p. 79). This means that all scientific data is based on subjective information. When we realise that what we usually designate as the realm of the objective actually consists of many subjective viewpoints, it might be fruitful to *replace the term objective with the term intersubjective*. I will do so from now on.

2.2.3 Two notions of objectivity

I propose to replace the term objectivity with intersubjectivity. When talking about objectivity, however, there are two notions which have to be distinguished since they are somewhat similar and thus easily confused. On the one hand, objectivity is used to denote the concept of a reality independent of any subjective viewpoint or bias. For the purpose at hand one could call this category *ontological objectivity* and this is the notion I propose to discard. As I tried to make clear, we do not have access to such a realm. On the other hand, objectivity is also used to refer to the scientific ideal of reducing subjective bias to a minimum when conducting experiments. One could call this category *methodological objectivity*. I have nothing against this notion of objectivity. It is actually very important and a bedrock of the scientific method.

2.2.4 Adjusting our vocabulary

Replacing the term objectivity with intersubjectivity might seem like hair-splitting but if we do not adjust our vocabulary in accordance to the insights of philosophy and modern science we will have difficulties embodying those insights. Words do have consequences. If I talk about intersubjectivity it necessarily involves the context of a system being informed and ultimately the involvement of at least one subjective viewpoint. The same cannot be said for the term objectivity.

2.2.5 The two research areas of science: intra- and intersubjectivity

We can now return to the statement that all information we have access to is ultimately subjective information. This realm of subjectivity can then be further divided into *intrasubjectivity* and *intersubjectivity*. Intrasubjectivity describes the information only one system has direct experiential access to. In the case of my system these phenomena include my thoughts and my emotions. Intersubjectivity on the other hand describes the information to which more than one system seems to have access. This information includes tables, neurons, the sun etc. It is worth pointing out that the realm of the intersubjective consists entirely of different systems' intrasubjective information. To state it again in explicit terms, *there are only two kinds of scientific data: intrasubjective and intersubjective data*.

The discussion of scientific data is important for one reason. If all intersubjective data consists of individual intrasubjective data, then *a refinement of*

one's intrasubjective measurement abilities will necessarily translate to the intersubjective domain.

2.3 Introducing inner psychology

Having established what kind of scientific data we have access to I am now able to look at the possibility of applying the scientific method directly to the mind. To do so I will introduce the terms inner and outer science, and inner and outer psychology, discuss why an inner psychology is now feasible, look at an example of inner psychology and consider some ancient hypotheses relevant for an inner psychology.

2.3.1 Inner and outer science

In the following discussion I will talk about the two realms of scientific data, the intra- and the intersubjective. Because those words are similar and might lead to confusion I will name the scientific pursuit focussing on intrasubjective data *inner science* and the focus on intersubjective data *outer science*. This distinction feels quite intuitive since inner science or the intrasubjective deals with phenomena usually regarded to be internal such as thoughts, emotions and other mental states; outer science or the intersubjective is concerned with data usually considered to be external, (e.g., tables, trees and neurons). From a general discussion of science we will now move to psychology.

2.3.2 Inner and outer psychology

William James defined psychology as "the Science of Mental Life, both of its phenomena and of their conditions."(James, 1891, p. 2). These phenomena include thoughts, feelings, desires, reasoning, decision making and the like (James, 1891). Any other natural science can focus exclusively on intersubjective data. Physics looks at particles and matter (at least until the dawn of relativity theory and quantum mechanics), chemistry looks at molecules and their interaction, biology looks at living organisms. The phenomena which interests psychologists, however, mental states and traits, are *intra*subjective in nature. William James, one of the forefathers of psychology, accordingly remarked more than a century ago that when studying mental phenomena introspection should be relied on "first and foremost and always" (James, 1890, 116). Introspection, of course, focuses exclusively on intrasubjective data. Franz Brentano, one of the predecessors of early psychology also found the

introspective method, or what he called descriptive psychology, to be the basic mode of inquiry in the study of psychology and regarded it to produce direct evidence of mental phenomena (Walach, 2013).

Despite early psychologists' advocacy of introspection as the primary means of investigation, contemporary psychology mainly investigates intersubjective data in the shape of neural and other physiological events and behaviour (behaviour includes speech acts in interviews, reports of subjective experience and questionnaires). These approaches, although highly successful in their own realms, measure what we believe to *correlate* with actual mental events. The information one encounters in this intersubjective domain are neurons, action potentials, behaviour, questionnaire data but *never* thoughts, emotions or other mental states and traits themselves. The study of brain and behaviour, focussing on intersubjectively available data, can thus be referred to as *intersubjective psychology*. I will also refer to this area as *outer psychology*.

In addition to investigating the mind using intersubjective methods, the study of behaviour and physiology, we might revive the tradition of exploring the realm of the intrasubjective directly. This science, like other natural sciences, looks at the phenomenon in question in its natural habitat. The phenomena in question include mental events, thoughts and emotions and the natural habitat of those phenomena is the subjective mind of the scientist. Investigating the mind in this way would entail regarding the movements of one's own mind as observable data and seeing the intrasubjective realm as a kind of laboratory. In this kind of investigation one focuses on the direct observation of mental states and traits. It is this kind of science which I will from now on refer to as *intrasubjective psychology* or *inner psychology*. As I have defined them, the terms *inner science* and *inner psychology* are synonymous and I will use them interchangeably.

As mentioned above, the idea to investigate mental content and mental states directly via introspection is not new to Western science. Around 1900 introspection was the method of choice employed by the pioneers of modern psychology and phenomenology (e.g., Husserl, Dummett, & Moran, 2002; James, 1891; Thompson & Zahavi, 2007). However, the introspection movement at the beginning of the 20th century was rather short-lived and was replaced almost entirely by the behaviourist paradigm (Robinson-Riegler & Robinson-Riegler, 2003). So one might ask why an

introspectionist science may be possible now when it had difficulties in the past. What has changed since the first big introspection movement?

2.3.3 Why an inner psychology is now feasible

Two main reasons suggest that an inner psychology is now feasible. First, a major obstacle for the first introspectionist movement seems to have been a lack of the right tools and technology for the reliable observation of mental content (Varela et al., 1991). In contrast to early introspectionists we now have access to much of the accumulated knowledge of contemplative traditions (e.g., Buddhism, Hinduism and Taoism) as well as to expert practitioners from these traditions (e.g., long-term meditators). In these traditions, many generations of practitioners have carefully and systematically observed the stream of consciousness, producing detailed catalogues of mental states and numerous techniques for calming, observing and transforming the mind (e.g., see Appendix B in Varela et al., 1991).

Contemplative practitioners have argued that one of the primary skills necessary for the direct observation of the mind is attention (Yates, Immergut, & Graves, 2017). Trying to observe mental events clearly without having undergone attention training has been likened to doing astronomy without a telescope (Wallace, 2007). The techniques and knowledge from the aforementioned traditions which we can now access include very detailed training regimes for refining attention (Varela et al., 1991; Wallace, 2006). This access to what might be called inner technology is a major reason why a thorough first-person approach to the mind might now be feasible. Rather than relying on normal introspection it now seems possible to rely on *trained introspection*.

Second, due to improvements in neuroscientific methods, we can now investigate the physiological correlates of mental faculties in greater detail and can track functional and structural changes in the brain. By comparing physiological correlates of well-defined mental states, we can make fine-grained distinctions between them (cf. section “A relationship of mutual benefit and constraint”). This has enabled neuroscience to identify brain areas or networks and activation patterns thought to be important for developing expertise in mental training and meditation (Brefczynski-Lewis, Lutz, Schaefer, Levinson, & Davidson, 2007; Hölzel et al., 2011; Lutz et al., 2009; Weng et al., 2013). This might, in the future, allow us to categorise correlates of different mental states and to compare different mental training

regimes. The collaboration between contemplative practitioners and neuroscientists has already led to a number of key findings: for example, neuroscientific studies with meditators have demonstrated that mental training may lead to beneficial cognitive and emotional changes (Lutz, Brefczynski-Lewis, Johnstone, & Davidson, 2008) as well as to lasting alterations in brain structures (Fox et al., 2014). Recent findings within the mind sciences indicate that our brains are far more plastic and malleable than previously thought (e.g., Pascual-Leone, Amedi, Fregni, & Merabet, 2005). Furthermore, neuroscientific research suggests that mental faculties (e.g., attention, compassion) can be trained (Lutz et al., 2009; Slagter et al., 2007; Weng et al., 2013) (see sections “Mindfulness”, “Attention” and “Dereification”).

2.3.4 An example of inner psychology

What I mean by inner psychology might become clearer using an example: *Tummo* is a meditation technique taught in Tibetan Buddhism (Thub-bstan-ye-śes, 1999), which has aroused public as well as scientific interest, not least because investigating practitioners of *tummo* showed that during meditation the temperature of their fingers and toes increased up to 8.3 °C (Benson, H., Lehmann, J., Malhotra, W.M. S. , Goldman, 1982). A recent study even found increases in core body temperature of up to 2.2° Celsius (Kozhevnikov, Elliott, Shephard, & Gramann, 2013). This temperature increase is equivalent to inducing a mild to moderate fever. The observed increase in temperature, however, can more accurately be seen as a by-product of the meditation. The real aim of the technique is the production of a certain psycho-physiological state, which is supposed to be characterised by feelings of bliss, luminosity and compassion (Thub-bstan-ye-śes, 1999). The meditation involves relaxation, visualisation and muscle contractions, or as Kozhevnikov et al. (2013) call them, “neurocognitive and somatic components” (p. 2). When these components are mastered not only does the desired psycho-physiological state appear but also the by-product of heat which, importantly, can be subject to external scrutiny. In order to test their abilities in this form of meditation monks traditionally go outside at cold winter days and put wet towels on their naked backs (Kozhevnikov et al., 2013). When practitioners are able to dry the wet sheets using their own body heat they can be said to have mastered the technique.

Let us look at this process from a scientific perspective. The process can be seen as an application of the scientific method directly to the mind. There is a

hypothesis: applying certain neurocognitive and somatic components and practicing them correctly for a certain amount of time will result in a specific psycho-physiological state. The prescribed techniques are learned, applied and fine-tuned in experimentation until finally the technique is mastered and the desired psycho-physiological state is reached. This is an example of an experiment done entirely within the confines of an individual's mind and body which, nevertheless, reliably produces certain outcomes, observable both from the first-person – the psycho-physiological state – and from the third-person perspective – the production of heat as signalled by the drying of the wet sheets or a measurable increase in body temperature. So we can conclude that *it is possible to apply the scientific method directly to the mind*.

This is also an illustration of inner and outer psychology and how they can work together within the inner psychology paradigm. The inner component is the experimentation within the mind of one scientist with the goal of reaching a certain psycho-physiological state. The outer component is the investigation of the heat which is produced and which is assumed to correlate with the psycho-physiological state. The ultimate goal of the entire practice, however, is the psycho-physiological state and not the drying of the sheets. The same holds true for the research paradigm of inner psychology: *the psycho-physiological state is the goal, not the correlate*.

2.3.5 Ancient hypotheses

This essay discusses several techniques derived from ancient wisdom traditions. An important question in this context is how we approach these traditions from a scientific perspective. When approaching ancient wisdom traditions there are two extreme positions to be avoided and there are certain dangers associated with each position.

The first extreme position is to buy into a tradition wholesale and to accept all dogmas by faith, the practical, philosophical as well as the religious ideas. The danger of accepting dogmas without questioning their validity is obvious in that it may lead one astray from the scientific method and build up false beliefs.

The second extreme position which is to be avoided is to dismiss all aspects of a particular tradition because of the presence of some religious ideas. The danger of this second position is that one might miss valuable practical insight and useful

philosophical ideas because of some religious ideas. This is a good example of throwing the baby out with the bathwater.

So when approaching ancient claims we have to be on the lookout for both of these tendencies. A useful approach is one of careful examination from a neutral, open but sceptic perspective. In this way one might be able to differentiate between unjustified religious dogma and valuable insight.

In the case of Buddhism this position might enable one to appreciate the complex philosophical ideas, the detailed catalogue of mental states the tradition accumulated and the techniques designed to calm and transform the mind, without having to accept metaphysical notions such as reincarnation. The tradition of Buddhism has accumulated a vast amount of expertise in mental training and "it would be a great mistake of western chauvinism to deny such observations as data and their potential validity" (Shear & Varela, 2000, as cited in Ataria, Dor-Ziderman, & Berkovich-Ohana, 2015). An open mind when approaching techniques taught within Buddhism is especially warranted considering that interventions based on mindfulness, one of the central techniques of Buddhism, have been shown to improve various conditions such as depression, anxiety, chronic pain and rheumatoid arthritis (Arias, Steinberg, Banga, & Trestman, 2006).

Furthermore, it is pointed out in Buddhist texts that claims regarding mental states or doctrines such as non-self are seen as discoveries and that they should be seen as hypotheses to be verified in one's own experience rather than be treated as dogma (Wallace, 2007). It would make sense that contemporary scientists do the same and see claims made within these traditions as hypotheses approaching them with an open mind and suspending judgment until the experiments necessary for the validation or falsification of the particular claim have been carried out. This is no special treatment but rather common sensible scientific practice. This remains true even when certain experiments might take twenty years and require sustained, disciplined effort and dedication.

This brings us to the important point that the *absence of evidence does not necessarily imply the evidence of absence* (e.g., Thompson, 2014). Not having experienced certain mental states does not mean that they are not possible or do not exist. This is especially true if one looks at the little amount of time and effort Western science has allocated to the systematic study and cultivation of mental states. The main reason for the lack of evidence regarding ancient hypotheses might

simply be that we have not investigated them thoroughly. As William James remarked in his chapter about the perception of reality: “The subjects adhered to become real subjects, the attributes adhered to real attributes, the existence adhered to real existence; whilst the subjects disregarded become imaginary subjects, the attributes disregarded erroneous.” (James, 2012, p. 291). Our focus of attention does not only have an influence over our momentary content of consciousness but also over the very subjects we investigate in science and by extension the subjects which we regard to be real. One sensible approach when investigating ancient wisdom traditions then would be to *regard ancient claims as hypotheses and to systematically and rigorously test these hypotheses*.

2.4 Practicing inner psychology

2.4.1 Basic principles and goals of inner psychology

The main goal of inner psychology is to gain a better understanding of the mind regarding content, underlying mechanisms and potential. Towards this goal we can see our own mind as a kind of laboratory and the stream of consciousness as observable data. This endeavour is governed by the scientific method and the scientific ideals (see sections “Setting up the inner laboratory”). The first step in the process is to set up our inner laboratory. This involves refining our measurement apparatus by training certain mental faculties, such as attention, mindfulness and metacognition, and by improving the signal-to-noise ratio regarding the signal we set out to measure (see sections “Setting up the inner laboratory” and “Attention”). There are also some other core principles we have to follow (see section “Other important concepts”). The aim of this process is to enable us to observe and describe mental events more accurately, make more fine-grained distinctions and find universal laws. In other words, we attempt to make the process of measurement and reification in which we are constantly engaging more visible and reveal the kinds of worlds we bring forth on a daily basis.

Furthermore, having familiarised ourselves with the process of measurement and having reached a state of high signal-to-noise ratio in which experimentation becomes possible we can engage in thorough experimentation with mental states themselves, trying to reliably bring them about, as has been seen in the example of *tummo*. This means that we might not only be able to become more aware of our habitual measurements but that we may also be able to recalibrate our measurement

systems to reliably make different measurements. In these efforts inner psychology has to rely on close collaboration with outer psychology (see section “Combining inner and outer psychology”).

2.4.2 The scientific method and its application in inner psychology

In order to discuss the application of the scientific method and ideals directly to the mind I first have to discuss the scientific method and ideals in general. In science we try to be *objective*, avoiding personal bias and prejudice wherever possible. Hypotheses are tested by conducting *experiments*. We try to get *valid* results which means that we are actually measuring what we set out to measure. We also want to be able to *reproduce* findings using a similar experimental setup which would imply high *reliability*. We build increasingly *better measurement devices* to make more accurate and fine-grained distinctions. Experimental results are reported in a *standardised format* which makes it easy to replicate studies. Individual results are checked by *peer review*.

While it seems clear how to apply the scientific method in outer psychology, how can it be applied in inner psychology? In one regard both disciplines are actually quite similar. In both instances one uses the scientific method to analyse, categorise and experiment with informational content. In both inner and outer science we have to develop certain skills necessary for conducting sound experiments.

However, there are also some key differences. First, outer psychology investigates the realm of the intersubjective which can be observed from more than one viewpoint. Inner psychology, however, focuses on intrasubjective phenomena which can only be directly accessed by one person. This might have some implications regarding reliability, peer review and the goal of objectivity which I will address below. Second, in outer psychology the researcher and participant are separate individuals. In inner psychology the researcher, the participant and even the measurement device are all combined in the same person. This might also cause one to question the possibility of minimising bias and achieving a certain level of objectivity.

The next section will look into these topics in more detail. The first part looks at ways in which the scientific method and scientific ideals can be applied in inner psychology. The training and application of certain techniques might give us more validity (see section “Attention” and “Stillness”), more reliability (see section

“Experimentation, reproducibility, reliability and peer review”) and more objectivity (see section “Mindfulness”, “Dereification”, “Non-interference” and “Experimentation reproducibility, reliability and peer review”). Some challenges and possible solutions regarding intrasubjective methods in general and the corroboration of intrasubjective results will be discussed in the section “Challenges for an inner psychology”.

2.4.3 Setting up the inner laboratory

There are certain core mental faculties which – when trained – might enable us to make more accurate, more fine-grained and more reliable observations in the realm of the intrasubjective. The mental faculties discussed in this section are attention, meta-awareness, mindfulness, and introspection. All of these mental faculties are related to a certain degree, some more than others. Many of them can be trained using the same set of exercises. The learning effects from the exercises I will discuss (e.g., focused attention meditation; see section “Attention”), have been called *process-specific*, which means that these exercises do not only improve performance on the trained task but also can transfer to new domains (Slagter, Davidson, & Lutz, 2011). I will explain the core mental faculties using some examples, mainly the exercise we did earlier attending to the sensations of one’s breath (see section “The importance of attention”). Before going into details about the core mental faculties I will more generally look at the process of adopting the scientific stance in inner psychology.

2.4.3.1 Adopting the scientific stance

The basic approach in inner psychology is to adopt the scientific stance towards all our experiences. We see ourselves as a scientist and a measuring system which has access to a stream of data. This stream is not seen as *personal* data but simply as information. Similar to the phenomenological reduction mentioned earlier we see mental content in terms of phenomena without ascribing to them any corresponding ontological validity apart from the phenomena themselves (see also section “dereification”).

2.4.3.2 Attention

We have already seen the way attention influences the momentary content of our consciousness. Training attention might not only give us more control over the process of reification but can also be seen as a necessary prerequisite for engaging with one’s own mind in a scientific way.

In his chapter on attention William James wrote that “the faculty of voluntarily bringing back a wandering attention, over and over again, is the very root of judgment, character, and will. No one is compos sui if he have it not. An education which should improve this faculty would be the education *par excellence*. But it is easier to define this ideal than to give practical directions for bringing it about." (James, 1891, p. 424, his italics).

Judging from his writings on religious experience (James, 1928) one might assume that James must have been aware of exercises in Buddhism which explicitly provide "practical directions for bringing it about". In fact, James description of "voluntarily bringing back a wandering attention, over and over again" could serve as a good working definition of focused attention (FA) meditation (Slagter et al., 2011; Wallace, 2006). FA meditation involves voluntarily focusing one’s attention on a chosen object in a sustained fashion, such as a visual object or image or the sensations of the breath (Lutz, Dunne, Davidson, & Zelazo, 2007). To sustain the focus on the object one has to monitor and regulate the quality of attention (Lutz et al., 2007). Slagter et al. (2011) list three regulatory skills involved: the monitoring faculty which remains vigilant to distractions, the ability to disengage from a distracting object without further involvement and the ability to redirect focus promptly to the chosen object. According to the Buddhist tradition, in the final stages of FA meditation one is said to be able to focus on a single object for hours on end with minimal or no distractions (Wallace, 2007; Yates et al., 2017).

Training one’s attention seems to be an indispensable prerequisite for observing mental content and making discoveries within subjectivity. As mentioned earlier, attempting to observe one’s inner life without having undergone attention training has been likened to doing astronomy without a telescope; one is able to see some stars and the sun and moon but would never be able to detect moons of Jupiter or the rings of Saturn (Wallace, 2007).

Usually we seem to be so caught up in our thoughts that we do not realise that we are engaged in reification. FA meditation promises to be useful in making the process of reification more visible. In FA meditation the focus on one’s breath provides a gap within the incessant stream of thought. This might allow one to become aware of a mental event which in turn may enable one to study it further.

Whether or not one can train one’s ability to pay attention has been investigated extensively in recent years. It should come as no surprise that

investigating this question has focussed to a large degree on meditation practitioners as participants who have spent thousands of hours honing their attentional abilities. This investigation has produced growing evidence that many aspects of the faculty of attention can be improved by training. This includes attentional stability (Lutz et al., 2009), perceptual discrimination and sustained visual attention (MacLean et al., 2010), increased control over the distribution of limited brain resources (Slagter et al., 2007) and general attention (Y.-Y. Tang et al., 2007). The work on attention training also identified a number of brain regions thought to be involved in the training of attention (e.g., Brefczynski-Lewis, Lutz, Schaefer, Levinson, & Davidson, 2007; Farb et al., 2007).

We can look at attention training in terms of signal detection theory. In the case of the attention exercise mentioned above the sensations of the breath represent the signal and all other mental data can be regarded as noise. The goal of an experimental session can be to achieve the highest signal-to-noise ratio possible. This process can be seen as increasing the validity of our experimental measurements because with better attention abilities we increasingly measure what we set out to measure.

2.4.3.3 Meta-awareness

Meta-awareness refers to the process in which attention is directed towards explicitly noticing the current content of consciousness (Smallwood & Schooler, 2015). A canonical example of meta-awareness in the case of watching one's breath is the moment one notices that one's attention has wandered from its designated target (Schooler, 2002). Training meta-awareness is an important task within inner psychology. In the case of watching your breath this faculty also monitors whether you are actually *feeling the sensations* of your breath or are merely *thinking about* your breath. Since most of us have not spent much time training our interoception and attention, disentangling sensations and thoughts about sensations can be tricky, especially for beginners (Varela et al., 1991). Meta-awareness can be trained using FA meditation, the same exercise which we can use to train attention. Training the faculty of meta-awareness is likely to improve one's awareness of mental events as a whole.

2.4.3.4 Mindfulness

Another core mental faculty which can help us make better observations of intrasubjective content is mindfulness. There is not one definitive definition of mindfulness but it has been referred to as a “dispassionate, nonevaluative and sustained moment-to-moment awareness of perceptible mental states and processes” (Grossman, Niemann, Schmidt, & Walach, 2004, p. 36). The mindful attitude has also been described as “non-reactive” and “non-judgemental” (Kabat-Zinn, 1990). This non-reactive approach goes against our tendency to habitually classify experiences as good or bad, pleasant or unpleasant (Kabat-Zinn, 1990). Mindfulness can thus be seen as an attempt to *develop a more and more objective approach to one’s subjective experience*. The focus on momentary experience can help us distinguish between immediate sensations and conceptual superimpositions, such as the sensations of the breath and thoughts about the sensations. In this capacity it is similar to meta-awareness which can be considered a part of mindfulness, but can also be conceptualised as a separate process (for a discussion about the relationship between meta-awareness and mindfulness see Jankowski & Holas, 2014). The mindful attitude is very similar to the scientific stance. Training mindfulness might help us become more aware of the content of our awareness without being caught up in it. Mindfulness is also trained in FA meditation.

In addition to being an invaluable tool for the observation of the mind, training mindfulness has been shown to have a number of health benefits (see section “Additional benefits of an inner psychology”).

2.4.3.5 Introspection and interoception

Another way to refine our measurement apparatus which is strongly related to mindfulness is to train introspection and interoception (for definitions of these terms see section 2.6.5. Introspection and interoception). Evidence suggests that both introspection and interoception can be trained (Bornemann & Singer, 2017; Fox et al., 2012): For example, long-term meditators have been shown to display much higher introspective accuracy than non-meditators (Fox et al., 2012; Lutz, Slagter, et al., 2008). Introspective accuracy was assessed using reports of tactile sensitivity for different body regions during a 'body-scanning' meditation with averaged, objective measures of tactile sensitivity as reported in prior research (Fox et al., 2012) and overall meditation experience was positively associated with introspective accuracy

which suggests higher introspection accuracy to be a result of training (Fox et al., 2012). One way to train introspection and interoception is FA meditation. Another technique used to train these faculties is the so-called “body scan”. In this exercise one scans the body from head to toe, allowing body sensations from all parts of the body to arise (Bornemann & Singer, 2017; Kabat-Zinn, 1990). In a recent study by Bornemann and Singer (2017) contemplative methods were practiced, including FA meditation and body scan, and steady increases in interoceptive accuracy were observed. In the same study it was also found that emotional awareness increased over time. This increase strongly correlated with increases in interoceptive accuracy (Bornemann & Singer, 2017). Thus, this suggests that we can learn to intrasubjectively measure more and more fine-grained distinctions regarding our thoughts and feelings and discover aspects of our inner lives which we were not aware of before.

2.4.3.6 Dereification

The aforementioned qualities can be trained using the simple task of attending to the sensations of the breath. This exercise might be able to make the process of thought formation or reification more visible. Another aspect which might help in the effort to explore the realm of the intrasubjective scientifically is the process of dereification. According to one definition this aspect reflects the degree to which emotions, thoughts and perceptions are interpreted as mental processes rather than accurate depictions of reality (Lutz, Jha, Dunne, & Saron, 2015). Lutz and colleagues (2015) point out that this concept of dereification has been called “phenomenological reduction” (Varela, 1996) or “mindful attention” (Papies, Barsalou, & Custers, 2012). Hölzel and colleagues (2011) depict a process similar to dereification which they describe as a "disidentification with the static sense of self" and a "detachment from identification with the contents of consciousness." It is also similar to adopting a neutral scientific stance towards experience.

The process of dereification can be illustrated using the example of open monitoring (OM) meditation. This technique has been described as non-reactively monitoring the content of experience from moment to moment without focussing on any explicit object (Lutz et al., 2007). OM meditation usually starts with FA meditation focussing on a certain object. After a while, when the mind is relatively stable, the focus on the object is reduced and more emphasis is placed on the

monitoring faculty (Slagter et al., 2011). Regarding dereification Lutz and colleagues state that “at the highest end of this spectrum thoughts lose their representational integrity and are experienced simply as mental events, situated and embodied within a field of sensory, proprioceptive, affective, and somatic feeling tones.” (Lutz et al., 2015, p. 639).

For the following I would like to distinguish between two meanings of dereification: (1) dereification in a weak sense – realising that thoughts are just mental events and not accurate representations of reality and (2) dereification in a strong sense – the process of moving towards mental states with less and less reifications culminating in objectless awareness.

After having trained attention and mindfulness and thus having refined our measurement apparatus to a certain extent we could then experiment with both weak and strong dereification. In the pursuit of more and more dereified mental states an interesting question emerges: in terms of measurement, what happens when we create less and less conceptual distinctions and superimpositions and get closer and closer to what James called “the immediate flux”?

A state which describes something along those lines in Buddhism is referred to as *Samadhi* which has been likened to a state of perfect symmetry with the highest possible entropy and degrees of freedom (Wallace, 2007). Of course, one might also argue that a state of objectless awareness due to its lack of discrimination would render the term entropy which is a measure of uncertainty meaningless. In terms of signal detection theory, in the final stages of OM meditation there might no difference between signal and noise anymore; all data could be regarded as signal or all data could be seen as noise. In the Buddhist tradition a concept pointing in this direction is the notion of the “one taste” of all phenomena (Wallace, 2007). One might interpret this to mean that all phenomena are seen simply as information. The state of *Samadhi* is said to be accompanied by a feeling of serenity and a surge of well-being unimaginable from the perspective of ordinary waking consciousness (Thub-bstan-ye-śes, 1999). Whether or not these states are possible and whether they are accompanied by feelings of bliss is an open question and should remain so until the experimental data regarding those questions are in. These data will have to be accumulated by many individuals in subjective experiments which then can be corroborated in the realm of the intersubjective.

Importantly, we can see dereification as moving towards more and more *objectivity within one's subjectivity*. Dissolving distinctions between mental and physical, internal and external and maybe even subject and object, could be seen as an attempt of reducing subjective bias in any possible way. Looked at in terms of the goals of phenomenology this process might be the ultimate epoché or phenomenological reduction not only bracketing the external world but dissolving the very categories the natural attitude is based on. These techniques might be able to advance the discipline of phenomenology in its goal of becoming an exact science of lived experience (see also section "Additional benefits of an inner psychology").

The context of dereification brings us to an important difference between inner and outer science. One could say that in the final stages of dereification one has to dissolve even the scientific method as it is commonly employed. We usually connect the scientific method to the processes of analysis, comparison and categorisation. In the final stages of dereification, rather than being useful these processes pose obstacles. Rather than adding more distinctions and categories one aims at letting them dissolve. Even effort or expectation might have to be surpassed when attempting to reach states of complete dereification. Of course in another sense this process would still employ the scientific method since the goal of reaching more and more dereified states is the explicit goal of the scientific endeavour and letting go of analysis and comparison is simply a tool towards this goal.

2.4.4 Other important concepts

There are some additional concepts which might allow us to enhance a direct scientific investigation of mental content. These are stillness, non-interference, positivity bias, experimentation, reliability and peer review.

2.4.4.1 Stillness

When wanting to observe a certain phenomenon in outer science we usually keep the measurement system, (e.g., a telescope), as still as possible to make reliable measurements. The same applies in internal science which would mean keeping our bodies as still as possible. This is recommended in many mental training manuals (Wallace, 2006; Yates et al., 2017). Of course, we cannot keep it completely still since we have to breathe. But one principle might be to avoid unnecessary movement. The ideal of stillness also applies to our minds (cf. section "Attention").

2.4.4.2 Non-interference

Outer science tries to make valid statements about the world. We want to ideally produce high ecological validity which means observing the phenomenon of interest in its natural habitat and interfering with it as little as possible. The ideal of non-interference equally applies to inner science. The principle of non-interference has also been discussed in ancient traditions. In Daoism it is called *wu wei* which could be translated as non-action or non-doing (Creel, 1970). *Wu wei* is one of Daoism's most fundamental principles and ideals (Creel, 1970).

Taking again the example of the breath, we want to *measure* the signal of the sensations of the breath *without interfering* with the breath as it naturally occurs. Whoever has tried watching the sensations of the breath knows how hard it is to follow this scientific ideal of non-interference. It takes a lot of time to reduce the tendency to change the signal one is supposed to passively observe. Following the ideal of non-interference can be seen as another way of reducing one's bias and moving more and more towards objectivity within subjectivity.

2.4.4.3 Positivity bias

The moment of realising that one is actually not measuring the intended signal but is rather lost in noise is crucial. In this moment, one of two things can happen. One can either congratulate oneself for noticing that one was lost in noise and happily return to the signal; or one can judge oneself to have failed at the task of watching the breath and angrily return to the signal. It is recommended to do the former (Yates et al., 2017), especially if you want to sustain a healthy career within inner science. This kind of positivity bias can be seen as a positive reinforcement strategy. Furthermore, a positive outlook rather than scepticism regarding the possibility of training one's mental faculties might be a necessary ingredient for the advancement in inner science.

2.4.4.4 Experimentation, reproducibility, reliability and peer review

As already explained above in the section "An example of inner psychology" using the example of *tummo* one can see the training of mental faculties in terms of an experiment. A hypothesis is expressed: if you apply these techniques for this amount of time with the right effort and dedication a certain outcome will appear. Regarding attention training an example of such an outcome would be the ability to

keep your attentional focus on the signal of your breath without being lost in noise for the duration of the experiment.

There are many aspects to the experimental approach in inner psychology. We can illustrate this, again, using the example of attention training. One aspect is the experimental training session in which the goal is to achieve a high signal-to-noise ratio. After each experimental session of aiming to increase our attention we can evaluate the previous experiment and think about implications for future studies. This entails thinking about lessons learned, evaluating the success of the experiment and thinking about changes in the experimental setup for future experiments. This might involve rating the amount of time spent on the signal compared to noise or the clarity and vividness of one's attention. One might also evaluate whether one congratulated or judged oneself in the moment of realising that the mind had wandered. The overall goal of these experiments is to increase the signal-to-noise ratio as systematically, efficiently and pleasantly as possible until the whole time of the experiment is spent exclusively on the signal which would mean the end of this particular line of research.

The result of one's studies regarding the training of attention can then serve as the basis for the next series of experiments dedicated to investigating mental phenomena in more detail or cultivating other mental faculties or mental states (e.g., memory or emotional regulation). Regarding the experiment about attention one can also add more levels. One might do an intersubjective experiment about the intrasubjective training of attention. One could compare different techniques by which different groups of people are attempting to increase the signal-to-noise ratio. One might also look at the neural and behavioural correlates of these different training regimes (see section "Attention"). One might also try to use external technology to shorten the time to reach certain states (see section "A relationship of mutual benefit and constraint").

This brings us to the two ideals of *reliability* and *reproducibility*. In outer science we aim to be able to *reproduce* findings, getting the same results using the same experimental setup. Achieving this gives an experiment high reliability.

In inner science these principles apply in two ways, intra- and intersubjectively. Regarding Intrasubjectivity this would mean that one inner scientist tries to repeatedly replicate certain mental states within him- or herself. To do this he or she will try to use the same experimental setup and keep as many variables as

possible constant from one experiment to the next. This intrasubjective process could be called *within-subject reliability*.

There is also an intersubjective component which could be called *between-subject reliability*. If in outer science a research group has made a new discovery in their lab, the usual reaction of other scientists is asking whether they can reproduce these results within their own lab. The same applies in inner science. Only, in this case our lab is our own mind. In the example of *tummo* we might ask, what components are necessary to reproduce this psycho-physiological state within our own measurement system. Is the subjective data as the other scientist claims? Are there more efficient ways of reaching this state? In order to allow the intersubjective corroboration of non-ordinary states of mind, a critical mass of scientists have to be trained in the basic techniques which are necessary for advancing to other states (cf. section “Challenges for inner science”).

The necessity of training a large number of people in inner psychology techniques is also necessary for the establishment of a system of *peer review*. Without a critical amount of individuals sharing the same expertise no peer review seems possible. This by the way also applies to outer science. Another important point which can enhance between-subject reliability is the systematic correlation between neural events and experience (cf. section “A relationship of mutual benefit and constraint”). Furthermore, another necessary factor for peer review seems to be the establishment of a common vocabulary and a universal notation system for mental states to communicate subtle differences between them (cf. section “A relationship of mutual benefit and constraint”).

2.5 Combining inner and outer psychology

2.5.1 A relationship of mutual benefit and constraint

Having discussed the basic principles of inner psychology we can now turn to the relationship between inner and outer psychology. Francisco Varela (1996) proposed a model for the relationship of neuroscience and phenomenology he called neurophenomenology. He stated that first-person accounts and the correlating third-person accounts relate to each other through reciprocal constraints. This might help to explore the bridges, challenges, insights and contradictions between these two approaches (Varela, 1996). This is a very good starting point for the discussion of the relationship between inner and outer psychology. I will look at the relationship in

terms of benefits one field can offer the other and ways in which collaboration might facilitate overcoming some of the challenges inner psychology is facing.

Varela (1996) pointed out that a disciplined account of experience can be of benefit for third-person cognitive science. An example of the contribution a disciplined, trained account of first-person experience can offer to neuroscientific research is a study by Lutz and colleagues (2004). In this study the authors found that while aiming to generate a state of non-referential compassion, Tibetan Buddhist monks self-induced high gamma synchrony within the brain. These results are likely due to the monks' years of rigorous training in attention, meta-awareness and emotional cultivation. In a second part of the study, the monks rated the clarity of their experience and it was shown that greater clarity highly correlated with stronger gamma frequency activity in the electroencephalogram (EEG). Importantly, without the subjective information regarding clarity, this correlative finding would not have been possible (Thompson, 2014). This goes to show that certain meaningful correlations between mental and brain states can only be established with the help of experts in mental faculties such as mindfulness, attention and meta-awareness and clearly demonstrates the usefulness of inner psychology for achieving the goals of outer psychology. There are some additional benefits of engaging in inner psychology which are discussed in the section "Additional benefits of inner psychology".

Outer psychology can also enhance the pursuit of the objectives of inner psychology which includes the goals of making more accurate, fine-grained intrasubjective observations and reliably bringing about mental states. Neuroscience, as an example of outer psychology, can contribute greatly towards the goal of cultivating certain mental states and is already doing so. It can help decode different mental states from brain activity (Haynes & Rees, 2006; Hinterberger, Kamei, & Walach, 2011), identify correlates of desirable mental states and techniques (Brefczynski-Lewis et al., 2007; Hölzel et al., 2011; Lutz, Brefczynski-Lewis, Johnstone, & Davidson, 2008) and help identify levels of expertise in practitioners (Lutz et al., 2004).

Another area in which outer psychology can enhance the cultivation of mental states is biofeedback. Biofeedback takes physiological measures, such as skin conductance, heart rate or brainwaves, from a person and feeds them back to the person the measures came from. This can help gain greater awareness regarding

bodily signals which otherwise would be harder or impossible to perceive. Biofeedback is used in a number of contexts but I will limit the discussion to the area of biofeedback and meditation.

Biofeedback may be used as an aid rather than a replacement for meditation (Brandmeyer & Delorme, 2013). The hope is that it can enhance the practice and enable the practitioner to reach certain mental states more quickly (Brandmeyer & Delorme, 2013). There have been two major approaches to enhancing meditation using biofeedback: (1) to train users to make their EEG signals similar to those of a meditation expert or (2) to provide an alarm when the practitioners' mind starts to wander (Brandmeyer & Delorme, 2013). Recent promising approaches aimed at aiding the avoidance of mind wandering, use signals from the posterior cingulate cortices (PCC), an area which has been associated with the default mode network[9] (van Lutterveld et al., 2016; van Lutterveld & Brewer, 2015). Another promising line of research combining visual and auditory biofeedback is the work done by Hinterberger and colleagues (e.g., Hinterberger, 2011). As knowledge of the brain's subsystems and mechanisms increases, so may the level of sophistication of biofeedback paradigms.

2.5.2 Challenges for inner science

One challenge for inner science is overcoming prejudice regarding the feasibility and usefulness of first-person approaches in general. First-person methods have been criticised in numerous ways (e.g., Dennett, 1991)[10]. Even William James, one of the foremost proponents of introspection stated that it "*is difficult and fallible"* (James, 1891, 191, his italics). But importantly he went on to say that "*the difficulty is simply that of all observation of whatever kind*." (James, 1891, 191, his italics). And it seems that neither inner nor outer science is infallible or unbiased. Regarding outer science, as we have seen in the discussion of quantum mechanics, there seems to be no completely unbiased experiment since the outcome of the measurement is necessarily co-defined by one's way of measuring. We have found ways in outer science to increase reliability and I have addressed a

[9] The default mode network is a network of interacting brain regions which are commonly assumed to be active when a person is in a state of wakeful rest, daydreaming or mind-wandering (Buckner, Andrews-Hanna, & Schacter, 2008).

[10] It is beyond the scope of this essay to give a detailed account of all the criticisms of a first-person approach but for a recent review of criticisms and possible responses see (Bitbol & Petitmengin, 2016).

number of ways which can help us work towards achieving greater accuracy and reliability in inner science (cf. section “Setting up the inner laboratory”).

This brings us to the next point. Considering the small role systematic mental training has played in Western science and philosophy it seems safe to assume that most persons denying that first-person approaches could be a valuable and reliable scientific tool have not undergone extended periods of attention and introspection training. It has been shown, however, that it is possible to train both attention (e.g., Lutz et al., 2009; MacLean et al., 2010; Y.-Y. Tang et al., 2007) and introspection (e.g., Bornemann & Singer, 2017; Fox et al., 2012; Lutz, Slagter, et al., 2008). Most of the criticisms facing introspection methods do not address *trained* introspection. As has been discussed above, training mental faculties is a key component and *prerequisite* for engaging in inner science and making accurate observations within.

Claims about the impossibility of introspection and the lack of systematic mental training contribute to a kind of vicious circle. Attempting introspection without having trained one’s attention and introspection skills will probably not yield reliable results and lead one to further doubt introspection as a scientific tool. This increased doubt will in turn strengthen one’s dismissal of the introspective method which will make it less likely that one will engage in mental training. The only way out of this vicious cycle seems to be to test the hypothesis that mental faculties can be trained and to encourage a large enough sample to engage in systematic mental training for a long enough time for effects to be able to show (e.g., Bornemann & Singer, 2017). On the basis of the results of such an investigation one could then re-evaluate one’s earlier judgements and preconceptions regarding introspection as a scientific method. This is, again, why the importance of *training* one’s mental faculties is one of the key arguments of this essay.

There is another point regarding introspection. I can illustrate this point using the example of *tummo* (see section “An example of inner psychology”). From a third-person perspective I could evaluate the mastery of the meditative technique on purely intersubjective grounds without referring to or even believing in the efficacy of introspection at all. The ability to dry the wet sheets with body heat is a strong indicator that the disciple has learned the technique. And, as pointed out before, we now have much more sophisticated “wet sheets”.

Neuroscientists can compare practitioners using imaging techniques and with time certain brain patterns underlying expertise will be very strong indicators of

mastery of techniques and associated mental states (see also section “A relationship of mutual benefit and constraint”). However, evaluating the mental state of another individual is probably improved if the person doing the evaluation also knows the mental state the person under evaluation is trying to produce. This stresses the importance for outer scientists to also engage in inner psychology. The more one knows about one’s own subjectivity the more one is likely to understand the mechanisms necessary to reliably reproduce mental states.

Another challenge inner science faces is due to the fact that the data one gathers and uses is only accessible from one subjective perspective. This means that it is not easy to verify claims from a third-person perspective and to corroborate results. William James recommended a threefold strategy to face the challenge of evaluating introspective reports: (1) intersubjective evaluation of first-person reports of their introspective experience, (2) investigation of behaviour correlating with such internal experiences, (3) investigating physiological correlates of internal experiences (James, 1891 as cited in Wallace, 2007). This is exactly the path that was recommended by Varela in his neurophenomenological approach (Varela, 1996). I will address each of these strategies.

One promising way to address the first strategy, trying to bring intrasubjective experience into the realm of the intersubjective, is the elicitation interview which aims at extracting rich information regarding a person’s momentary subjective content (Bitbol & Petitmengin, 2016). Without going into too much detail about this technique, it involves “guiding subjects towards exquisite contact with their experience” and “retrieving the data extracted from these disciplined descriptions” (Bitbol & Petitmengin, 2016, p. 70). For a good example of this technique being used regarding non-ordinary states of mind see Ataria et al (2015).

These interview techniques might also help with another challenge, namely to establish a more accurate vocabulary for describing and communicating mental states. A source of inspiration regarding vocabulary might again be ancient wisdom traditions such as Buddhism. Their focus on observing the stream of consciousness directly, has produced a very rich vocabulary for the description of mental states and subtle differences between them (Fischer-Schreiber, 1986). One example of this is the literature discussing the *Jhānas* which describe subtle differences between stages of deeper and deeper concentration (Wallace, 2006; Yates et al., 2017). These differences are important since each different stage of concentration is

associated with different pitfalls to avoid and certain techniques to apply in order to advance to the next stage of concentration (Yates et al., 2017).

The second and third part of the strategy prescribed by James of correlating internal experiences to behaviour and physiological processes respectively are already quite developed. One example of this already mentioned is the study by Lutz et al. (2004) (see section “A relationship of mutual benefit and constraint”). Another good example of this effort is the ReSource project which in the context of mental training gathered much behavioural and neurophysiological data and correlated these data with subjective reports (Bornemann & Singer, 2017; Singer, T., Kok, B. E., Bornemann, B., Zurborg, S., Bolz, M., & Bochow, 2016).

2.5.3 Additional benefits of inner psychology

The main goal of inner psychology is to observe and experiment with intrasubjective data in a scientific way. Achievements in this domain would have obvious benefits for the field of psychology as a whole. Furthermore, practicing inner psychology might have some additional benefits and implications.

First, one additional benefit might be that practicing these inner techniques is likely to be conducive to well-being. Benefits have been especially well-documented regarding mindfulness training which has been found to reduce stress and to increase relaxation and calmness among other benefits (for recent meta-analyses and reviews see Gotink et al., 2015; Sharma & Rush, 2014; Y. Y. Tang & Posner, 2013).

Second, in remembrance of the quote from William James that an education training one’s attention would be “the education *par excellence”* and in light of the evidence suggesting that attention can in fact be trained, systematically improving one’s attention is also likely to be useful for research in outer science.

Third, investigating mental phenomena using first-person methods may give scientists new perspectives on mental phenomena which may create insight and spark new research paradigms in inner as well as outer psychology.

2.5.4 Implications for philosophy

There might be some additional benefits for the field of philosophy. Philosophy traditionally mainly relies on purely theoretical research and logical reasoning. This type of philosophy has been called “armchair philosophy” since you can do it without leaving your armchair. One of the tools used by armchair

philosophy is the thought experiment, the goal of which is to make explicit or challenge some of our intuitions about philosophical topics. Examples of thought experiments are the “Chinese room experiment” or “Mary the colour scientist” (Blackmore, 2010). This is a valid form of confronting pressing philosophical questions and has been used for millennia.

A recent movement in philosophy is so-called experimental philosophy which, in addition to logical reasoning and theorising, also relies on conducting experimental studies of peoples’ ordinary intuitions (Knobe, 2007; Knobe & Prinz, 2008). The claim is that experimental philosophy can provide novel information on philosophical topics which purely theoretical approaches cannot provide (Knobe & Prinz, 2008). I believe that this is a step in the right direction but would propose to go further than that.

In addition to that, I argue, it would be fruitful to conduct what could be called *real* thought experiments. What I mean by this is to do experiments with thought or within thought akin to the techniques of inner science mentioned before. In order to have a realistic chance of making philosophical discoveries within one has to undergo extensive training in attention, mindfulness and, importantly, dereification techniques (Wallace, 2006, 2007). Training the mind using these techniques might provide a valuable tool to engage in truly empirical philosophy. Examples of questions which we might be able to tackle this way are whether the stream of consciousness is continuous or discontinuous (Thompson, 2014), whether consciousness always displays intentionality, whether objectless, pure awareness is possible (Thompson, 2014; Wallace, 2007) or whether the subject-object distinction can be experientially transcended (Metzinger, 2009; Thompson, 2014). Regarding the latter there is phenomenological evidence to suggest that it is possible to dissolve what has been called the “self-boundary” (Ataria et al., 2015). Trained in attention and mindfulness techniques we might shed light on these issues in a way which differs drastically from both armchair philosophy and empirically informed philosophy.

The establishment of this empirical philosophy might have to overcome some obstacles. One difficulty is that training the necessary introspective abilities takes time, probably years. Another difficulty might be that the standard philosopher’s toolkit, consisting of logical reasoning, analysis and conceptual thought, can at some point be considered an obstacle for making discoveries within and will ultimately

have to be dropped in the final stages of a deep investigation of consciousness (cf. end of section “Dereification”; Wallace, 2007).

3 Outlook

Considering the previous discussion it would seem reasonable to establish an inner psychology within the mind sciences. This last section will look at some of the necessary steps towards its implementation. One important step is to raise consciousness about the possibility of an inner science and I hope that this thesis can make a small contribution towards this goal.

Another straightforward approach to establishing inner psychology would be to integrate these new perspectives into the psychology curriculum. This would be achieved by designing a new course of psychology which explores topics of interest from both the first- as well as the third-person perspective; valuing classical theoretical knowledge but at the same time engaging in systematic mental training. Taking the example of attention this would entail learning about attention research, the neural mechanisms underlying it and about the history of the field theoretically and at the same time practically exploring one’s own attention, experimenting with different techniques and ultimately aiming to investigate the nature and potential of one’s own attention. Other topics such as memory or emotions could be approached in a similar fashion.

Since most of the techniques discussed in this thesis come from the tradition of Buddhism it is worth pointing out that regarding school or university education techniques should be taught in a thoroughly secular, culturally appropriate way predicated on evidence-based practices (Davidson et al., 2012). Tackling topics in a theoretical as well as in an experiential way is not only likely to paint a more complete picture of the mental process at hand but is also likely to be more engaging and rewarding for the student as it shows real-life applications for their theoretical knowledge.

It needs to be noted that there are already signs of an integration of first-person methods into the context of university education. Recently, Thomas Metzinger (2016) invited applications for the Mental Autonomy Program (MAP) at the University of Mainz. This 3-year PhD program includes training in philosophy of mind, cognitive science and meditation. The meditation part includes meditating twice a day, participating in an 8-week mindfulness-based stress reduction course

and spending 20 days in silent meditation retreats. In the program description, meditation training is considered a means to making discoveries within subjectivity and for incorporating the first-person perspective in research (Metzinger, 2016).

Another example of this integration is a course which will be taught in the winter semester of 2017 in the master's program at the Berlin School of Mind and Brain at Humboldt University in Berlin. The course is entitled "Applying the scientific method directly to the mind – An introduction to the theory and practice of first-person methods" and will be taught by the author and Dr. Vera Ludwig. This course will introduce the students to the theory, and importantly, the practice of inner science.

4 Conclusion

In conclusion, we have seen the trend in both philosophy and modern physics to move away from a metaphysically real, substance-based, observer-independent view of the world and instead point to the ultimately embodied, observer-dependent, subjective and informational nature of reality. The picture which emerges from these views stresses the importance of potential, process, interaction and measurement. The world can be seen in terms of a chain of measurements. As I tried to show in this thesis, these concepts can not only be seen as theoretical abstractions but can also be grasped using everyday examples and analogies.

Furthermore, we do not seem to be passive observers of a pre-existing universe but are rather active participants in an emerging world. We are involved in the co-creation of a world whether we are aware of it or not. The process of measurement does not only seem to bring forth a world but also a self. This self, however, is not the unitary, immutable and independent self which we intuitively assume ourselves to be, but instead it is an ever-changing process which is emerging from and continuously updated in the interaction of measurement. The result of this notion of being part of an ultimately participatory universe might be a sense of empowerment but also of responsibility. It might inspire us to take a closer look at our own measurements and the worlds we bring forth.

A key question then arises how we can embody these theoretical insights and better integrate them into our scientific practice and also our daily lives. One path might be a deep investigation of the very process of individual reification and measurement. In addition to the already well-established methods of outer science

we could establish an inner science with the aim of studying mental phenomena directly. To do so we have to turn our scientific gaze inwards, see ourselves as measurement devices, see the stream of consciousness as observable data and systematically and thoroughly apply the scientific method directly to our mind.

Refining our measurement devices using mental training techniques might allow this scientific endeavour to flourish. We might not only become more aware of our measurements but also be able to reliably cultivate and produce mental states. There are a number of challenges on this path which we may address using a close collaboration of inner and outer science. The collective effort of inner and outer science is likely not only to provide us with a more complete picture of the mind but might also help us to bring forth more sustainable worlds. Combining an inner and outer perspective on the mind in an effort to *measure all things* may ultimately even enable us to move towards experiencing non-dual *no-thing-ness.*

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