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RELIABILISM, TRUETEMP AND NEW PERCEPTUAL FACULTIES

ABSTRACT. According to the thought experiment most commonly used to argue against reliabilism, Mr. Truetemp is given an unusual but reliable cognitive faculty. Since he is unaware of the existence of this faculty, its deliverances strike him as rather odd. Many think that Truetemp would not have justified beliefs. Since he satisfies the reliabilist conditions for justified belief, reliabilism appears to be mistaken. I argue that the Truetemp case is underdescribed and that this leads readers to make erroneous assumptions about Truetemp's epistemic situation. After examining empirical studies of actual subjects who, like Truetemp, have received new perceptual faculties, I show that Truetemp must have been endowed with all of the reorganized neural circuitry and cognitive skills that subjects with new perceptual faculties normally acquire during a long and difficult process of adaptation and development. When readers realize how much more the designers of Truetemp's new faculty had to do than simply slip an artificial device under Truetemp's scalp, I find that they no longer think his beliefs would be unjustified. Because the thought experiment fails to support anti-reliabilist intuitions when further details of the case are made explicit, the Truetemp thought experiment does not constitute a clear and decisive counterexample to reliabilism.

1. INTRODUCING THE PROBLEM

Reliabilists offer the following analysis of justified belief.

R1) *S*'s belief in *p* is justified iff it is caused (or causally sustained) by a reliable cognitive process, or a history of reliable processes. (Goldman 1994, 309)

A process' reliability is determined by the ratio of true to false beliefs produced by that process. If a belief is produced by a highly reliable cognitive process, that belief will have a high degree of justification. Beliefs will be unjustified just when they are produced by unreliable processes. Many epistemologists claim that simply being formed by a reliable process is not sufficient to make beliefs epistemically justified. Others maintain that process reliability is not even necessary for justification.

Many critics of reliabilism use the same kind of counterexample to argue for the inadequacy of reliabilism. The most widely discussed version of the counterexample is Keith Lehrer's (1990, 162 ff.) story of Mr.

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Truetemp. Truetemp is kidnapped by mad cognitive scientists who implant a device (variously called a 'tempucomp' or a 'doxatemp') in his skull that provides him with reliably true beliefs about the temperature of his immediate environment. Since the crazed researchers administer an amnesia-inducing drug to make Truetemp forget about the kidnapping incident, Truetemp is completely unaware of the existence of the device and, consequently, of its reliability as well. When the doxatemp begins to operate, Truetemp finds himself with very strong and precise beliefs about the surrounding temperature. These temperature beliefs seem to overtake him from out of the blue and strike him as rather odd. He has never felt doxastic compulsions of this sort before, and they do not arise from any perceptual source known to him. Nevertheless, he unreflectively accepts the deliverances of the doxatemp.

Reliabilism requires that a justified belief be produced by a reliable cognitive process – nothing more. Since the doxatemp is stipulated to be reliable, Truetemp appears to satisfy all of the reliabilist conditions for justified belief. But, the objection reads, surely there is something wrong with the epistemic status of Truetemp's out-of-the-blue temperature beliefs. And since he satisfies all the reliabilist requirements, surely reliabilism is mistaken. Many internalists take the Truetemp counterexample to highlight the central difficulty facing any reliabilist epistemology. In fact, even some reliabilists – including Alvin Goldman (1992, 1994) and William Alston (1989) – grant that the objection raises serious problems for reliabilism. In this article I argue that the Truetemp thought experiment does not succeed as a counterexample to reliabilism.[1]

The logical structure of the Truetemp objection can be made explicit as follows.

1) *S*'s belief in *p* is justified iff it is caused (or causally sustained) by a reliable cognitive process, or a history of reliable processes.
2) If (1) were true, it would not be possible for *S*'s belief in *p* to be produced by a reliable cognitive process and for that belief to fail to be justified.
3) The content of the Truetemp thought experiment is clearly possible.
4) If Truetemp's temperature beliefs were produced by a reliable process like the doxatemp, his temperature beliefs would be justified.
5) But it is absurd to think that Truetemp's temperature beliefs would be justified.
6) Therefore, (1) is false.

Statement (1) is simply the reliabilist analysis of justified belief, while (2) draws a relevant modal implication from that analysis. (3) asserts that Truetemp is a possible being; and statement (4) spells out an important consequence of the conjunction of (2) and (3). (5) reports an evaluative intuition concerning the Truetemp case that the objector thinks will be widely shared.[2] I will call the thought expressed in (5) the 'Truetemp intuition.' Statements (1) through (5) form a logically inconsistent set. The inconsistency can be resolved by giving up one of the claims in that set. In (6) the Truetemp objector recommends rejecting (1).

A significant feature of the Truetemp objection that (1) through (6) make clear is that there is more to the objector's task than simply demonstrating that Truetemp is a possible being. It is evident that (5) does not follow directly from (3). This means that the purely descriptive stipulations about Truetemp's new perceptual faculty do not jointly entail any normative conclusions about the epistemic status of Truetemp's doxatemp-produced beliefs.

In this paper I will provide reasons for rejecting the Truetemp intuition. An 'intuition,' as I will use the term, is a defeasible, evaluative judgment given in response to a particular case. L. Jonathan Cohen (1986, 75) writes,

> In this sense 'His intuition is that *p*' does not imply the truth of *p*, and even the assertion of 'My intuition is that *p*' does not commit the speaker to having reflectively accepted that *p*. An intuition that *p* is now just an immediate, unreflective, and untutored inclination, without argument or inference, to judge that *p* (and that anyone who faces the same issue ought also to judge that *p*), where the judgement that *p* is of a kind that is in principle not checkable by sensory perception or by accepted methods of calculation.

A proposed conceptual analysis is taken to be adequate only if it squares with widely held intuitions about the application of the target concept to particular cases. Those who subscribe to the Truetemp intuition believe that the reliabilist analysis of justified belief is mistaken.

Among those who share the Truetemp intuition, there is nothing remotely approaching agreement about how to explain it – i.e., about what exactly the problem with Truetemp's epistemic situation is. Alston (1989), for example, claims that the Truetemp intuition arises from our recognition that Truetemp does not have the minimal kind of access to the justifying ground of his belief that is required for epistemic justification. Laurence BonJour (1985, 38) claims that, because Truetemp would be "highly irrational and irresponsible in accepting a [doxatemp-produced] belief, when judged in light of his own subjective conception of the situation," his belief could not be justified. According to Lehrer (1990, 164–5), the problem with Truetemp is that, although the doxatemp provides him with correct information about the surrounding temperature, he has no reason for thinking he possesses any such accurate information. Alvin Plantinga (1993, ch. 9) maintains the real problem is that the doxatemp was not part of the original design plan for Truetemp's cognitive faculties. In short, there are almost as many explanations of the Truetemp intuition as there are non-reliabilist theories of justification. The aim of this paper is not to engage the various theoretical perspectives from which these explanations are offered. Rather, my goal will simply be to undermine the Truetemp intuition itself.

Intuitions, like scientific data, can be discounted for a variety of reasons (cf. Cohen 1986, §11). If a scientist's experimental set-up is faulty, her experimental findings may be misleading or false. Sometimes a hidden variable can interfere with the action of the controlled variables so that the scientist's results do not indicate the actual causes of the outcomes. In such a case, one can reject the experimental findings by exposing the operation of the hidden variable(s). Undermining the results of a particular scientific experiment does not necessarily provide any reason for rejecting a theory that claims some degree of confirmation from the experiment. Whether that theory should be rejected will also depend upon what other kinds of supporting evidence are available.

Analogously, one might argue that an intuition given in response to a particular philosophical thought experiment should be rejected because unstated assumptions lying behind the thought experiment have misled readers into forming incorrect judgments. In this case, the unstated assumptions will be the philosophical analogue to the scientist's hidden variables. If it can be shown that misleading factors are operative, it may be permissible to dismiss the intuitions elicited by a certain thought experiment. One might also reject an intuition on the grounds that the thought experiment that elicited it was described in a question-begging fashion. To undermine such an intuition, one might retell the story from a different perspective and show that a contrary intuition results (cf., for example, Williams 1973, 46–63).[3] Intuitions might also be rejected as unauthoritative if they conflict with other, allegedly canonical intuitions (Cohen 1986, 97ff.). It is important to note that undermining the intuitions given in response to a thought experiment does not necessarily provide any reason for rejecting theories that claim some degree of confirmation from the thought experiment. It merely shows that these theories need to look elsewhere for evidential support.[4]

My attack on the Truetemp intuition falls into two parts. First, I expose unstated assumptions about the case that act as hidden variables, skewing philosophical intuitions in what I take to be the wrong direction. Most of the article is devoted to carrying out this part of the project. In the second part of the project, I ask readers to consult their intuitions about the Truetemp case a second time. This time, however, they will give their intuitive responses to the Truetemp case in light of the assumptions and facts that have been brought to light during the course of the paper. Having readers reconsider the Truetemp case in light of new information is like repeating a prior experiment while controlling for previously hidden variables. When I ask readers to consult their intuitions about Truetemp at the end of the paper, I believe that most of them will no longer find the story of Mr. Truetemp to be a compelling counterexample to reliabilism.

I begin the first part of my project by examining an array of empirical studies of actual subjects who – like Truetemp – receive new perceptual faculties (NPFs) that are initially experienced as awkward or weird. The subjects include congenitally blind patients who receive sight after corrective surgery, cochlear implant recipients, and subjects given various artificial devices which provide novel forms of sensory input or which distort ordinary sensory input. In every documented case where subjects receive NPFs, they are unable to use their NPFs to form any beliefs at all during the first moments those NPFs are operational. Subjects experience shock and confusion and must go through a difficult period of adjustment. As one researcher put it, forming beliefs using an NPF "represents indeed a difficult achievement for the patient" (Valvo 1971, 18).

I then generalize from these cases and formulate a set of necessary conditions that anyone who receives an NPF must satisfy before forming noninferential beliefs using the NPF. These conditions are ordinarily satisfied during the process I call 'NPF development.' If NPF subjects fail to satisfy any particular condition of NPF development, it is not that their beliefs fail to be justified. They fail to have NPF-generated beliefs altogether. The conditions of NPF development highlight the cognitive role of temporal factors, neural integration, neural plasticity, training, the acquisition of cognitive skills, and the ability to correlate deliverances of the device with the deliverances of other faculties.

The various factors involved in ordinary NPF development suggest that there are two important variables that are left uncontrolled in the Truetemp thought experiment. One such variable is time. Without explicitly saying so, the story of Truetemp leads readers to focus on the very first moments when Truetemp's doxatemp is operative. It is essential that Truetemp be able to form noninferential, doxatemp-produced beliefs during that time. The Truetemp case could not function as a potential counterexample to reliabilism if it pictured Truetemp several years after implantation. During the intervening years he would have had the opportunity to satisfy whatever internalist justification conditions critics of reliabilism may think are necessary for justified belief. Immediately after implantation, however, Truetemp can plausibly be viewed as satisfying only reliabilist justification conditions.

The second and most important hidden variable is the extent to which the mad scientists had to reorganize Truetemp's neural circuitry on the night of implantation. Standard ways of telling the Truetemp story make it seem as if the mad cognitive scientists did nothing more than stick an artificial device under Truetemp's scalp. If our intuitions tell us that this would be insufficient to endow Truetemp with all of the cognitive facility he needs to form justified beliefs using his doxatemp, they are correct. Empirical studies of actual NPF cases reveal that, even if an NPF device is fully functional at implantation, NPF subjects must go through a difficult period of NPF development before they can use it to form any beliefs. If Truetemp is able to form doxatemp-produced beliefs from the start, then the mad scientists who engineered the doxatemp had to have done much more than simply slap a doxatemp on his head. They must have either:

a) endowed Truetemp with all of the reorganized neural circuitry and cognitive skills that are normally acquired during NPF development; or
b) since we are imagining a merely possible world that may not obey the physical laws of the actual world, endowed Truetemp with some otherworldly equivalent to the results of NPF development.[5]

As we shall see, enabling Truetemp to bypass the normal process of NPF development was no small task for the mad scientists. Much of the article is directed toward showing what a significant and complex achievement this must have been.[6]

Because the Truetemp case is underdescribed, the aforementioned variables are left uncontrolled. In section 10 of the paper I repeat the Truetemp thought experiment while controlling for these variables. In other words, I direct readers to consult their intuitions about the Truetemp case in light of the facts of NPF development. I have found that readers who were initially attracted to the Truetemp intuition reject that intuition when they more fully understand the details of the case. They no longer think that Truetemp's doxatemp-produced beliefs would be unjustified.[7]

Of course, many philosophers who are strongly committed to non-reliabilist theories of justified belief will not be persuaded by my attempt to undermine the Truetemp intuition. It will be significant, however, if most of those who lack strong, prior theoretical commitments are persuaded by it. The strength of a philosophical thought experiment or counterexample depends entirely upon its ability to compel assent from our evaluative intuitions. If my redescription of the Truetemp case in light of the facts of NPF development is successful in leading many to give up the Truetemp intuition, it will be a welcome defense of reliabilism.

2. SUMMARY OF CASE STUDIES

I will begin by briefly describing various types of actual subjects who have received new perceptual faculties (NPFs). Sometimes the new faculties are artificial devices designed to compensate for perceptual deficits. In other cases damaged or deprived sensory organs are restored through corrective surgery.

A. *Recovery from Early Blindness*

Subjects who have either lost their sight very early in life or been congenitally blind and who have their sight restored as adults are more like Truetemp than perhaps any other type of NPF subject. A new perceptual world is opened up before them rather suddenly when their surgical bandages are removed.[8]

B. *Cochlear Implants*

Cochlear implants are neural prostheses which help to restore auditory perception to those with certain types of hearing loss. The device consists of a microphone, a sound processor, and an array of electrodes implanted in the deaf patient's cochlea. The microphone, placed behind the ear, takes in auditory information and passes it on to the sound processor. The processor, worn on a belt or carried in a pocket, translates the microphone signal into a set of four to eight electrical stimuli, which are transmitted to an electrode array. The electrodes directly stimulate auditory nerve fibers, generating patterns of nerve activity that mimic those of a normal ear for a wide range of sounds (Eddington and Pierschalla 1994).

C. *Tactile Vision*

In the late 1960s and 1970s Paul Bach-y-Rita pioneered the use of sensory substitution devices that provide visually impaired subjects with spatial information about distal objects. The tactile vision system he developed consists of a television camera (mounted either on the subject's head or on a stand near the subject's head), a processor, and a system of 400 vibrators strapped to the subject's back. The processor translates visual data from the camera into patterns of tactile stimulation projected onto the subject's back. For example, a small circle in the upper left of the camera's field of view would be experienced by the subject as a circular pattern of vibratory stimulation in the upper left of the subject's back.

D. *Perceptual Adaptation with Distorting Goggles*

Psychologists in the second half of the twentieth century have extensively studied the effects of wearing distorting or inverting goggles. Some goggles turn the world upside down; some reverse right and left directions; some turn the world upside down and reverse right and left directions; and some use prisms to displace visual images laterally with some distortion.

E. *Echolocation*

Echolocation devices, like tactile vision systems, are sensory substitution devices. That is, they provide an intact sensory modality with a novel kind of perceptual information that would normally be processed by another sensory modality that is damaged. Echolocation devices such as the Binaural Sensory Aid are mounted to the subject's head and send out ultrasonic signals in all directions. Two detectors receive and process the echoes of these signals as they are deflected by distal objects, which are then translated into auditory cues. Pitch is often used to indicate the height of an object in what would normally be the subject's visual field, while the discrepancies between the sounds heard by the right and left ears indicate lateral position relative to the subject. Differences of amplitude usually indicate distance.

3. THE FIRST MOMENTS

What sort of beliefs do ordinary NPF subjects form during the first moments their NPFs are operational? Are they reliably formed beliefs that lack justification? It turns out that NPF subjects typically do not form any beliefs at all.[9] Valvo (1971, 48) reports that those restored to sight after long periods of blindness – unlike those who have lived with sight for most of their lives and experience only a short period of blindness – experience "a latent period of variable length during which the patients perceive nothing." Subjects then "experience a confusing proliferation of perceptions, and they must learn to see as a child learns to walk" (Valvo 1971, 4).[10] After experimenting with an echolocation device (the Binaural Sensory Aid), Warren and Strelow (1984, 348) write,

> we found in these experiments that there was no immediate understanding of the information provided by the sensors. Instead, a period of learning was required to understand the nature of the codes.

Fryauf-Bertschy et al. (1997, 184) made similar findings with cochlear implant patients. The shock and confusion that accompany an initial encounter with an NPF are often of such great intensity as to induce varying degrees of psychological trauma to NPF subjects.[11]

Advanced cognitive, physiological or social development in NPF subjects does not mean that they will be able to skip NPF development or progress through NPF development at a quicker pace than less developed subjects. Robinshaw and Evans (1996) studied a cochlear implant patient, Adam, who received his implant at age 2 years 5 months and was switched on one month later. Although Adam's development of speech production and comprehension was behind that of hearing children, some of Adam's skills emerged at normal "hearing age." For instance, normally hearing infants evidence auditory comprehension of frequently heard phrases and rhymes at around 12 months while Adam exhibited this sort of comprehension 12 months after his cochlear implant was switched on (Robinshaw and Evans 1996, 93). Although he acquired this ability at an older age than is typical (3 years 6 months), it took him twelve months of hearing before he did so – just like a normal hearing child. At 2 years 6 months Adam had to begin at the same developmental starting point vis-à-vis hearing as a newborn.[12]

4. SOME INITIAL BELIEFS

A. *Cross-Modal Information Transfer*

There are two apparent exceptions to the principle that NPF subjects cannot form any NPF beliefs during the first moments that their new perceptual modalities are operational, but as we shall see, they are not genuine exceptions after all. The psychological literature reveals that subjects who do form beliefs during their initial exposure to NPFs form beliefs of only the following two types: cross-modal information transfer beliefs and inferential beliefs. When perceptual information from one sensory modality is stored in a form that makes that information immediately accessible to other modalities – including NPFs – NPF subjects are sometimes able to form limited kinds of beliefs immediately.

For example, S.B. (an early blind patient restored to sight as an adult) was immediately able to recognize capital letters and numbers by sight as soon as the bandages were removed from his eyes because he had learned their shapes by touch during his childhood education. He was not, however, given lower case letters to touch as a child and he learned to recognize them visually only with great difficulty (Gregory 1997, 156). Although the shapes of capital letters and numbers were initially learned through the sense of touch, these patterns were not, as some have hypothesized, stored in long-term memory in a unique ‘tactile-code’ that is untranslatable into codes specific to other sensory modalities. The stored patterns were immediately activated by S.B.’s visual experiences and matched to visually perceived patterns.[13] Recent studies by Andrew Meltzoff (1993) and others corroborate Gregory and Wallace’s (1963) claim that NPF subjects can avail themselves of cross-modal information transfer.[14]

B. *Inferential Beliefs*

The only other documented cases where NPF subjects are known to form beliefs in the first moments their NPFs are operative involve inference. Describing S.B.’s initial visual experiences, Gregory (1997, 154) writes

> When the bandages were first removed from his eyes, so that he was no longer blind, S.B. heard the voice of the surgeon. He turned to the voice, and saw nothing but a blur. He realized that this must be a face, because of the voice, but he could not see it. He did not suddenly see the world of objects as we do when we open our eyes. But within a few days he could use his eyes to good effect.

S.B. was unable to form *noninferential* beliefs about what he was seeing but used knowledge he had acquired through another faculty (viz., hearing) to *infer* that he must be seeing a face. Valvo’s patient no. 3 experienced much the same thing as S.B. after being restored to sight. The patient writes,

> My first visual impressions after the operation were fairly vague and confused. I remember having seen a moving shape, which I understood afterwards to have been the Professor’s hand; and a bright light on this shape, which later I learned was the ring on his finger. The ‘moving things’ I saw later proved to be his fingers. (Valvo 1971, 14)

Information acquired some time after his initial visual experiences enabled him to interpret retrospectively what he had been seeing. Again, inference from information acquired through other perceptual faculties was used when noninferential belief formation was not possible. Later, both men were able to form the sort of noninferential visual beliefs using their NPFs they were initially denied.

Consequently, if an NPF subject is able to form some beliefs using her NPF during the first moments the NPF is operational, it is either because of cross-modal information transfer or inference. In both cases subjects rely upon information from intact sensory modalities. Both types of belief formation are largely replaced by noninferential belief formation when the NPF becomes fully operational.

5. COGNITIVE SKILLS AND PRACTICAL TASKS

One of the skills learned during NPF development is the ability to interpret the meaning or significance of the signals received via an NPF. For example, tactile vision subjects must learn that the patterns of vibrotactile stimulation on their backs are *about* objects in front of them.

> With training, the blind subjects can identify and correctly locate in space complex forms, objects, figures, and faces. ... The subjective localization of the information obtained through the television camera is not on the skin; it is accurately located in the three-dimensional space in front of the camera, whether the skin stimulation matrix is placed on the back, on the abdomen, on the thigh, or changed from one of these body locations to another. (Bach-y-Rita 1972, ix)

Once the skill of subjective localization is acquired, it does not require explicit or conscious control to be used in particular cases.[15] Cochlear implant patients, users of the Binaural Sensory Aid, and other NPF subjects initially face similar challenges in interpreting the meaning of the novel stimuli they receive.

Extensive research has shown that bodily movement under the active control of the NPF subject while accomplishing practical tasks is an important factor in an NPF subject's learning to interpret the significance of an NPF's signals. Commenting on tactile vision experiments, Bach-y-Rita (1972, 99–100) writes,

> Using a fixed camera [i.e., one that subjects are unable to control], subjects report experiences in terms of feelings on the skin, but when they move the camera their reports are in terms of externally localized objects ... We suggested ... that external localization of percepts depends critically on such movements and suggested that a plausible hypothesis is that a translation of the input that is precisely correlated with self-generated movement is the necessary and sufficient condition for the experienced phenomena to be attributed to a stable outside world.

Other studies confirm the importance of subjects' active control of NPFs during NPF development.[16]

6. TRAINING

Arno et al. (1999) have demonstrated the importance of training in NPF development. They developed an auditory substitution (i.e., echolocation) system for vision, in which frequency of pitch indicated the height of objects and binaural differences indicated their horizontal position. Subjects were asked to identify shapes. Members of a control group were subjected to tests four times and were not allowed any training. They did not improve significantly during the sessions. The experimental group was given intensive training with feedback from the experimenters. There were ten training sessions, spread across six to seven weeks. Their performance improved significantly from session to session. They took less time to complete the tasks and their accuracy improved. The results of their study show that "intensive training is necessary to achieve this task properly in order to improve both response accuracy and processing time" (Arno et al. 1999, 1027).

Similarly, all recipients of cochlear implants go through extended periods of post-operative therapy and training. Almost everyone in the implant patients' environment has normal hearing and therapies are designed with a clear idea of what optimal speech and auditory recognition performance is like. The therapies are designed to aid the patient in acquiring the competence of average hearing adults. Without such training, cochlear implant patients could not achieve success in using their NPFs.[17]

7. PLASTICITY

The possibility of a subject's being able to master an NPF is in part a function of the plasticity of key regions of the subject's cerebral cortex (and sometimes the cerebellum as well). The brains of NPF subjects must be plastic enough to adapt themselves to the processing of novel stimuli from their NPFs. Bach-y-Rita, whose work has been focused on brain plasticity in general and plasticity as it pertains to tactile vision in particular, writes,

> adults who were blind since infancy (and therefore had major changes in visual pathways and central representation), and had acquired the capacity to perceive visual images through a tactile sensory system, *had to reorganize their brain mechanisms to do so*. Positron emission tomography scan data support that conclusion. (Bach-y-Rita 2000, 371, emphasis added)

> In order to effectively use information from a tactile display [i.e., from a tactile vision system], particularly if it is used as part of a sensory augmentation system, *the brain must mobilize a number of mechanisms* that can collectively be included in the definition of brain plasticity. . . . These require time and practice to mobilize. (Kaczmarek and Bach-y-Rita 1995, 395, emphasis added)

According to the National Institutes of Health Consensus Statement on cochlear implants (1995, 11), it is only because auditory neurons in the congenitally deaf have the plasticity to respond to and reorganize their behavior in light of electrical stimulation from cochlear implants that such implants are possible. NPFs such as cochlear implants need more than auditory nerve cells that are alive – they need auditory neurons that are sufficiently pliable to become capable receivers and translators of novel auditory information.[18]

Sometimes the requisite plasticity is not available. This can be seen in a comparison of prelingually and postlingually deafened children and adults that receive cochlear implants. ‘Prelingually deafened’ means the subject became deaf before acquiring speech; ‘postlingually deafened’ means the subject lost their hearing after learning to speak. According to the NIH (1995, 8–10), prelingually deafened adults receive significantly less benefit from cochlear implants than either postlingually deafened adults or prelingually deafened children (ages 2–3). In both of the latter cases the patients have the ability to hear during their primary language acquisition phase. Members of the former group (prelingually deafened adults) did not hear during primary language acquisition and are trying to hear for the first time as adults, long after acquiring sign language. In humans there is a narrow window of time during which primary language acquisition is programmed to occur. The highly plastic mechanisms in the child’s brain responsible for language acquisition enable very young cochlear implant recipients to adapt to the unusual stimulus information they receive from their NPFs. In prelingually deafened adults, these enormously adaptable mechanisms are not available.[19]

8. PRINCIPLES OF NPF DEVELOPMENT

Case studies of actual NPF subjects support the following principles of NPF development.

- During the first moments NPFs are operational, NPF subjects experience tremendous shock and confusion and are unable to form noninferential, NPF-produced beliefs.
- If NPF subjects are able to form beliefs using their NPFs during the first moments, it is only because: a) information acquired by an undamaged faculty is accessible to the NPF through cross-modal information transfer; or b) the subject draws inferences that incorporate information from both an undamaged faculty and the NPF.
- Advanced cognitive, physiological or social development in NPF subjects do not necessarily mean that they will progress through NPF development at a quicker pace than less developed subjects.
- NPF subjects must learn that the new stimulations or sensations they experience carry information about distal objects so that they can make correct attributions about the properties of distal objects.

- Mastery of the cognitive skills needed for NPF development is acquired only when feedback is available in the course of accomplishing practical cognitive tasks.
- NPF subjects must learn to integrate their NPFs with motor systems and other faculties they already possess in order to accomplish practical tasks using their NPFs.
- Even if an NPF is fully operational at the time of implantation (or repair, etc.), NPF subjects require extensive training before they can use it reliably.
- The amount of time per day a subject spends using an NPF significantly affects the rate of NPF development (cf. n. 9).
- One of the reasons time is required before NPF subjects become fully adapted to their NPFs is that networks of neurons must be reorganized in order to support the processing of new information from the NPFs.
- Subjects cannot adapt to NPFs if their neural architectures are insufficiently plastic and are unable to adapt to and process the novel perceptual stimuli generated by NPFs. The age at which a subject acquires an NPF may affect the ability of that subject's brain to integrate the NPF, insofar as plasticity and the mechanisms that support plasticity are a function of age.

9. TRUETEMP AND NPF DEVELOPMENT

I now want to apply the foregoing principles of NPF development to the case of Mr. Truetemp. Ordinary NPF subjects are unable to form noninferential NPF-produced beliefs from the very beginning. Truetemp, however, is immediately able to form doxatemp-generated beliefs. If he can do this, he must already satisfy every condition that ordinary NPF subjects come to satisfy during the long and difficult process of NPF development (or, if the psychological or physical laws of his world are different from our own, he must already satisfy some otherworldly equivalent to these conditions). When actual NPF subjects are initially able to form some beliefs using their NPFs, it is always because of cross-modal information transfer or inference. In contrast, Truetemp's doxatemp is so well designed that it does not need to rely upon either cross-modal information transfer or inference to issue in precise doxatemp-produced beliefs. The mad cognitive scientists that kidnapped Truetemp and implanted the doxatemp in his head must have found a way to reorganize his neural circuitry to make him pre-adapted to his NPF and to endow him with all of the cognitive skills he needs to use the NPF.[20]

Although Truetemp had always formed general beliefs about temperature like "It must be in the 90s today" before receiving his doxatemp, he had never had an inclination to believe that it was exactly 93.54°. The skill of perfect calibration must already be built into him by the doxatemp designers if this is to be possible without training. If his precise recognitional capacities require stored perceptual representations with high degrees of resolution, then presumably the crazed cognitive scientists endowed him with a set of those as well.

NPF subjects must learn to interpret and use information from their NPFs to make correct attributions about the properties of distal objects. But this is not something that Truetemp needs to learn. From the first moment his doxatemp is operative he is able to interpret the meaning and significance of his sensations and to make appropriate and reliable attributions of temperature to his immediate environment. No process of trial and error is necessary because he is reliably correct from the very first trial.

We have also seen that advanced cognitive, physiological or social development neither obviates the need for nor speeds up NPF development. So, Truetemp's age, intelligence or maturity cannot be what is responsible for his immediate capacity to use his doxatemp. All credit must go to the crazed designers of the doxatemp. Moreover, actual NPF subjects require extensive training and practice before they can use their NPFs, but Truetemp requires no such training or practice. He possesses all of the cognitive skills he needs from the first minute. This means that the doxatemp's designers not only had to build an artificial belief-forming device but also had to reconfigure the relevant portions of Truetemp's brain that support the cognitive skills he would have acquired during a normal regimen of practice and training. Issues of plasticity do not arise for Truetemp because the mad scientists apparently did not cross their fingers and hope that his neural circuitry would be sufficiently plastic to adapt to the doxatemp over time. Instead, they seem to have directly intervened and made sure that Truetemp's brain was already adapted to the device.

In order to acquire the cognitive skills necessary to use NPFs reliably, normal NPF subjects also need to have active control of their NPFs, to receive feedback, and to coordinate their NPFs with other faculties and motor systems while accomplishing practical tasks. No such feedback or coordination is necessary for Truetemp. The doxatemp designers also implanted the doxatemp in a way that avoids any complications introduced by Truetemp's unfamiliarity or passivity with respect to the device.

Case studies of actual NPF subjects reveal that noninferential NPF-belief formation is a significant achievement. It is plausible to conclude that, in order to make doxatemp-belief formation possible for Truetemp, the doxatemp designers must have either:

a) endowed Truetemp with all of the reorganized neural circuitry and cognitive skills that are normally acquired during NPF development; or
b) since we are imagining a merely possible world that may not obey the physical laws of the actual world, endowed Truetemp with some otherworldly equivalent to the results of NPF development.

10. RETHINKING TRUETEMP

Consider the following questions: Who is more likely to be able to form *noninferential, NPF-produced beliefs* immediately after implantation? An NPF subject who has been endowed with all of the reorganized neural circuitry and cognitive skills that are normally acquired during NPF development or an NPF subject who has not been so endowed? Who is more likely to have *justified beliefs*? An NPF subject who has been endowed with all of the reorganized neural circuitry and cognitive skills that are normally acquired during NPF development or an NPF subject who has not been so endowed?

I invite readers to reconsider their thoughts about the epistemic status of Truetemp's temperature beliefs. In light of what you now know must have happened in order for Truetemp to be able to form noninferential, doxatemp-produced beliefs immediately after implantation, do you still think that Truetemp's doxatemp-produced temperature beliefs would be unjustified? Does the Truetemp intuition still appear to be the correct verdict on the case? I have found that almost everyone with whom I have discussed these questions thinks that Truetemp's beliefs would indeed be justified. Even if they found the Truetemp intuition initially attractive, they no longer accept it once they know the facts about NPF development.

The problem with the original version of the Truetemp story is that it is underdescribed.[21] When thought experiments are insufficiently detailed, readers unwittingly fill in the gaps with their own assumptions. Sometimes the added assumptions do not cause any problems. For instance, without being directed to do so, readers of the Truetemp thought experiment implicitly but correctly assume that they should consider Truetemp immediately after implantation. Since this assumption is correct, no untoward consequences follow from making this assumption.

However, readers also implicitly assume that the doxatemp designers did nothing more than slip an artificial device under Truetemp's scalp.

I have given reasons for thinking that this assumption is false. In every documented case where subjects receive NPFs, they are unable to form noninferential, NPF-produced beliefs from the start. Even if the NPFs are fully functional at implantation, they must go through a difficult period of adaptation and development. The assumption that the mad scientists did *not* endow Truetemp with all of the reorganized neural circuitry and cognitive skills that are normally acquired during NPF development (or its otherworldly equivalent) leads readers of the Truetemp story to think that something must be wrong with Truetemp's cognitive situation. Critics of reliabilism interpret this feeling of unease as the Truetemp intuition, which they then use to argue against reliabilism. However, when readers are confronted with their own implicit assumption about the lack of NPF development and with reasons for thinking this assumption is incorrect, I have found that they very often give up the Truetemp intuition.

When thought experiments are underdescribed, important factors that can influence the outcomes of those experiments are left uncontrolled. Since the extent to which the mad scientists reorganized Truetemp's neural circuitry is not specified in the story, readers are left to make their own assumptions about what happened. When, however, the variable of NPF development is controlled, different intuitive judgments result. The success of a philosophical thought experiment depends entirely upon its ability to compel assent from our evaluative intuitions. Thought experiments that fail to give uniform intuitive results when they are more fully described cannot command our intuitions as powerfully as those that do give uniform results. Because the Truetemp intuition wavers when further details of the case are made explicit, the Truetemp thought experiment cannot be taken to be a clear and decisive counterexample to reliabilism.

It is important to note that, if I am successful in undermining the Truetemp intuition, this does not necessarily provide any reason for rejecting non-reliabilist theories of justification that have claimed some degree of confirmation from the Truetemp thought experiment. It does, however, show that these theories need to look elsewhere for evidential support.

NOTES

1 It is important to distinguish genuine forms of the counterexample from other seemingly problematic cases. For example, all four of BonJour's (1985, 37–45) widely discussed clairvoyance examples are typically assumed to represent the same kind of problem for reliabilism as the Truetemp case when, in fact, only one of them does. In each of BonJour's cases an agent is stipulated to have a reliable clairvoyant power. In three of the four cases, however, the subjects have defeaters of some kind for their beliefs. The fact that certain agents have defeaters for reliably produced true beliefs is not a problem for

reliabilism because reliabilist justification is defeasible (cf. Goldman 1986, 63). Truetemp presents a formidable challenge to reliabilism because he has no reasons that defeat the justification of his doxatemp-produced beliefs *and yet* things seem amiss. Only BonJour's fourth clairvoyant subject presents a similar challenge.

[2] Cf. Sorensen (1992, ch. 6) for more details on the logical structure of counterexamples.

[3] Bernard Williams (1973) claims that "body swap" thought experiments often beg the question against theories of personal identity that emphasize bodily continuity. To say that two persons, *A* and *B*, have "swapped" or "exchanged" bodies is already to imply (question-beggingly) that whoever inhabits *A*'s body after the swap is not going to be *A*.

[4] Cf. Wisniewski (1998) and Shafir (1998) for more details on how erroneous intuitions can be generated in experimental situations.

[5] I should emphasize that I am *not* claiming that *if* Truetemp *were* to go through normal NPF development, then his beliefs *would be* justified. I am following the authors of Truetemp-style counterexamples in looking at the beliefs Truetemp forms from the very beginning.

[6] Describing the received view of evaluating counterfactuals, Sorensen (1992, 268) writes,

> When evaluating a counterfactual of the form 'If *p* were the case, then *q* would be the case', we are instructed to go to the nearest possible world in which *p* is true and then check whether *q* is true. If *q* is true, then so is the counterfactual. If *q* is false, then the counterfactual is false. Since the nearest possible world tends to be one that resembles the actual one, we have a legitimate expectation that familiar facts will be the same in both worlds.

In the nearest possible worlds in which the antecedent of (4) is true, there are many subjects who, like Truetemp, receive new perceptual faculties that are reliable but whose initial workings seem strange to the subjects. In each of these cases, NPF development is required.

[7] It is this difference in response that is my primary evidence that the two hidden variables cited in the text are responsible for the formation of the Truetemp intuition.

[8] Operable cases of blindness are of only two kinds: cataract of lenses and opacity of the corneas (Gregory and Wallace 1963, 2). Strictly speaking, these are cases of near-blindness, since the retina must be functional and the eye tissues cannot be completely opaque. From 1020 until 1968, there have only been 22 known cases of early blind patients to receive sight as adults from surgical intervention (Valvo 1971, 40). Since corneas are readily available for transplants and because of improvements in surgical techniques, adult cases of recovery from early blindness are rarely found in the developed world any more. The only recent studies of recovery from early blindness are all in Japanese journals of psychology. The only library in the U.S. that owns these journals, located at the National Institutes of Health, has been unwilling to supply me with photocopies of these articles.

[9] According to Gregory (1997, 153),

> The [newly sighted] patients could see but little at first, being unable to name or distinguish between even simple objects or shapes. Sometimes there was a long period of training before they came to have useful vision, and indeed in many cases it was never attained. Some gave up the attempt, reverting to a life of blindness, often after a period of severe emotional disturbance.

Generalizing from his studies of blind subjects restored to sight by surgical intervention, Valvo (1971, 48) describes the typical stages such subjects go through:

> At the outset there is a latent period of variable length during which the patients perceive nothing. Immediately after this there is a sudden and rapid development of visual perceptions which are almost instantaneous, and rich in detail. It is as if there is an accumulation of visual memories during the period of latency, and that a limit is reached beyond which what is observed is understood, albeit only roughly. After the first period of rapid progress there is a crisis in visual learning characterized by psychic depression. In the successive stages a sense of space and depth is acquired gradually.

[10] Valvo (1971, 18) writes, "It is commonly believed that an individual blind for many years, or even from birth, regains his vision quickly to normal levels once he is operated upon .... In reality, sight is not a gift in such cases, but represents indeed a difficult achievement for the patient."

[11] According to Valvo (1971, 22, 28),

> Immediately after surgery there is an initial phase of shock, followed by depression. ... [T]he majority of blind persons recovering vision after many years of blindness are liable to a depressive state that lasts for varying lengths of time.

Factors other than the difficulty of forming beliefs with the NPF also contribute to the ensuing depression. Cf. also the tragic demise of Gregory and Wallace's (1963) patient S.B.

[12] In addition to the duration of time spent practicing with an NPF, Fryauf-Bertschy et al. (1997, 183) also found that the "amount of daily use of the implant significantly affects all measures of speech perception performance except pattern perception." In general, minimal and eventual non-users of cochlear implants had lower scores on hearing tests in each age group compared to full-time users and on most tests did not improve their test scores over time (Fryauf-Bertschy et al. 1997, 189).

[13] This evidence proves that John Locke and William Molyneux were mistaken about what perceptual abilities a newly sighted would have. Molyneux posed the following question in a letter to Locke:

> Suppose a man born blind, and now adult, and taught by his touch to distinguish between a cube and a sphere of the same metal, and nighly of the same bigness, so as to tell, when he felt one and the other, which is the cube, which the sphere. Suppose then the cube and sphere placed on a table, and the blind man to be made to see; *quaere*, Whether by his sight, before he touched them, he could now distinguish and tell which is the globe, and which the cube? (cited in Locke 1689/1975, bk. II, ch. ix, 8.)

Molyneux, Locke and eventually Berkeley agreed that the blind man would not be able to make the proposed identification – primarily because they did not believe that cross-modal information transfer was possible.

[14] Meltzoff (1993) studied neonatal imitation of facial expressions and found that there is an automatic information transfer between what an infant sees and its proprioceptive sense of the shape of its own facial expressions. Meltzoff (1993, 229) writes,

> In this case the infants tested were truly newly sighted. The youngest infant in the study was just 42 minutes old. We can say with assurance that the capacity to imitate certain facial acts is truly an innate aspect of the human mind. When the newly sighted infant sees certain human gestures he or she can immediately mimic these acts. Such facial imitation entails cross-modal functioning: the infant can see the adult's actions, but he cannot see his own face; indeed has never seen his own face in his entire life.

> There is some primordial connection between our own acts and the acts we see others perform.

Meltzoff (1993, 222–4) also found that infants can recognize immediately by sight differently shaped pacifiers (smooth vs. nubbed) that they have only touched with their tongue.

[15] To illustrate this point, Bach-y-Rita (1972, 98–9) relates the following story.

> For example, a blind subject was exploring a checkerboard display one day when the board on which the display was mounted fell forward onto the camera, producing a looming effect as it fell. A few days later, while the same subject was moving the camera across a display of objects, the experimenter moved the zoom control level (which, like movement, aperture, and intensity, is normally under the control of the subject). The change in visual angle produced by the zoom lens changed produced a looming effect, and the startled subject raised his arms and threw his head backward to avoid the "approaching" object. It is noteworthy that, although the stimulus array was, at the time, on the subject's back, he moved *backward* and raised his arms in front to avoid the object, which was subjectively located in the three-dimensional space before him.

The subject showed a response that was not only directed toward the object in front of him but also reflex-like in its immediacy.

[16] Further support can be found in an experiment performed by Held (as cited in Epstein 1967, 224), in which human subjects wore prismatic goggles that displaced visual images laterally by about 20° with some distortion. In one part of the study, subjects walked freely along a typical outdoor campus path. In another, subjects sat in a wheel chair that was pushed along the same path. The difference between the two conditions was significant. Subjects actively walking showed greater signs of adaptation to the goggles than those passively wheeled through the same path. There is a tremendous difference between the mere stimulation of a region of cortex and that same stimulation being coordinated with actively controlled movements. Only the latter leads to cognitive development. Similar experiments on kittens raised in darkness (Bach-y-Rita 1972, 77; Gregory 1997, 143–4) underline the importance of integrating NPFs with other perceptual and motor systems during NPF development.

[17] Bach-y-Rita describes the various stages of training for users of tactile vision systems as follows.

> After being introduced to the mechanics of operating the apparatus, subjects are trained to discriminate vertical, horizontal, diagonal and curved lines. They then learn to recognize combinations of lines (circles, squares and triangles) and solid geometric forms. After approximately 1 h of such training, they are introduced to a "vocabulary" of twenty-five common objects: a telephone, chair, cup, toy horse and others. With repeated presentations, the latency or time-to-recognition of these objects falls markedly [from 5–8 minutes to 5–20 seconds (Bach-y-Rita 1972, 5)]; in the process, the students discover visual concepts such as perspective, shadows, shape distortion as a function of viewpoint, and apparent change in size as a function of distance. When more than one subject is presented at a time, the subjects learn to discriminate overlapping objects, and to describe the positional relationship of three and four objects in one field. . . . As the blind subjects become more familiar with objects, they learn to recognize them from minimal or partial cues. (Bach-y-Rita et al. 1969, 963–4)

[18] Bach-y-Rita (1972, 53) cites several studies to support the claim that adaptation to NPFs requires significant neural reorganization and plasticity, including Shlaer's study of kittens raised with prisms in front of their eyes to induce a vertical disparity. At four months of age, a sample of the kittens' binocular cortical cells revealed an abnormal distribution of specialized cell structures. They were shifted in a direction which would tend to compensate for the prism-induced disparity.

In another study, Hubel and Wiesel (as cited in Bach-y-Rita 1972, 51–2) performed experiments on kittens deprived of vision at birth. After having their sight restored after a few months of visual deprivation, what vision the kittens did develop occurred only after long periods of training, there was no sign that nerve cells in the visual cortex underwent any kind of recovery (Bach-y-Rita 1972, 66). Bach-y-Rita concludes that other cortical areas must be responsible for taking over the functions normally performed by cells in the visual cortex. Even if other cortical areas have been devoted to carrying out different sorts of specialized information processing, it seems they can be co-opted to subserve NPF processing. Bach-y-Rita (1972, 67) claims to have shown that "(except for its general role in all sensory analysis and higher intellectual functions), the visual cortex may be unnecessary in vision substitution."

[19] Certain kinds of neurological damage can block the neural reorganization required for NPF development. In a study conducted by Martin et al. (1996), subjects wore spectacles with wedge prisms that shifted the subjects' visual field about 17° laterally and were asked to throw balls of clay at a target. Normal subjects initially threw in the direction of the prism-bent gaze but, with repeated throws, adapted to hit the target. When the spectacles were removed after adaptation, the subjects' gaze returned to normal but they missed the target to the opposite side by an amount almost equal to the initial prism-induced error. However, some of the subjects in the experiment had lesions in their olivocerebellar system and most of these subjects were unable to adapt to the prisms.

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[21] The same is true for analogous thought experiments, such as BonJour's (1985) fourth clairvoyance case.

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