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## THE TRUTHMAKER SOLUTION TO THE GETTIER PROBLEMS

*Abstract.* A truthmaker solution to the Gettier problems is based on the idea that knowledge can be defined as justified true belief provided that the source of one's justification is suitably connected with what makes the believed proposition true. Different developments of this basic intuition have been recently criticized on the basis of a series of arguments aiming at showing that no truthmaker theory can allow us to solve Gettier problems, since the very idea underlying such solution is ineffective. In this paper, I discuss the criticism to the truthmaker solution I consider most promising and show how it can be successfully addressed.

*Key-words:* epistemology, knowledge analysis, knowledge definition, Gettier problem, justification, truthmaking.

*Riassunto:* Una *truthmaker solution* dei problemi di Gettier è basata sull'idea intuitiva che è possibile definire il concetto di conoscenza come credenza corretta e fondata a patto che si richieda che la fonte della giustificazione sia connessa in modo opportuno con lo stato di cose che rende vera la proposizione creduta, e quindi corretta la credenza. Recentemente, i tentativi di soluzione che derivano da questa idea sono stati criticati sulla base di una serie di argomenti tesi a stabilire che nessuna soluzione di questo tipo può essere efficace. Il presente articolo intende analizzare questa critica e mostrare in che modo possa essere rigettata, argomentando a favore della soluzione ai problemi di Gettier che considero più promettente.

*Parole-chiave:* epistemologia, analisi della conoscenza, definizione della conoscenza, problema di Gettier, giustificazione; *truthmaking*.

### 1. Introduction

A truthmaker solution to the Gettier problems is based on a straight intuition: knowledge can be defined as justified true belief provided that the source of one's justification is suitably connected with what makes the believed proposition true.

In the current literature, this idea has been differently articulated. A basic version of the truthmaker solution was originally proposed in (Jacquette 1996), where it was firstly acknowledged that the problem that arises in Gettier cases is that, in the definition of knowledge, the relation

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that must obtain between the state of affairs that justifies belief in a proposition and that which makes the proposition true is not specified. Similarly, in (Heathcote 2006), it is noted that Gettier problems arise because, in the cases proposed, the state of affairs which is the truthmaker for the believed proposition is not identical to the state of affairs from which the evidence for the belief is drawn. The basic solution is further developed in (Heathcote 2013), where the notion of evidence of a state of affairs is analysed and the principle of the transmission of evidence through entailment is rejected, as one of the main cause of the problems. In particular, a distinction between evidence of a state of affairs and evidence for a proposition is introduced. The same solution is differently developed by Giordani (2013), in a wider framework, in which the distinction between explicit and implicit justification and the distinction between accessible and non-accessible states of affairs play the crucial role. A different account is proposed in (Bernecker 2011), where it is required that the truthmaker and the state of affairs we have evidence of co-varies across possible worlds. Finally, these various positions have been recently criticized by Vance (2014), who argues that no truthmaker theory can allow us to solve Gettier problems, since the very idea underlying such solution is ineffective.

In this paper I discuss what I consider, along the lines of Vance (2014), the most promising criticism to the truthmaker solution and show how it can be addressed. The paper is divided as follows: in the rest of this section, the basic ways in which the Gettier problems arise are sketched; in section 2, the common structure of the problems is highlighted; in section 3, a partial solution to the problems is proposed and Vance's criticism is reported; finally, in the last section, a complete solution to the problems is advanced and defended against that criticism.

Let  $\langle p \rangle$  be a proposition.<sup>1</sup> Let us assume, in accordance with the current interpretation of the classical analysis of knowledge, that we know that  $p$  precisely when (i) we believe that  $p$ , (ii) we are justified in believing that  $p$ , and (iii)  $p$  is true. Then, the Gettier problems arise. To be sure, two simple schemas for generating Gettier problems are available.

**Fake Object Schema.** Suppose you are justified in believing that  $x$ ,

<sup>1</sup> I use angle brackets to refer to the proposition expressed by a particular token of a sentence type. Since to know that it is raining coincides with knowing that the proposition that it is raining is true, I'm assuming that, in general, to know that  $p$  coincides with knowing that  $\langle p \rangle$  is true.

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which you know to be an object characterized by a certain set of traits  $S$ , should be in a certain region  $r$ , and  $x$  actually is in that region. You see an object, different from  $x$  but characterized by  $S$ , in  $r$ . So you form the belief that  $x$  is in  $r$  and this belief is justified by your seeing an object indistinguishable from  $x$  in  $r$ . Since  $x$  actually is in  $r$ , you are both justified in believing that  $x$  is in  $r$  and right in believing it. But, intuitively, you don't know that  $x$  is in  $r$ .

**Example 1:** Sara is a reliable person. She has agreed to meet you at the zoo at noon. At noon Sara is at the zoo and, when you arrive, you see someone who looks exactly like Sara, saying to you that she is Sara. You form the belief that Sara is at the zoo now. As it turns out, the person there is Sara's twin sister, who you did not know existed.

**Fake Kind Schema.** Suppose you are justified in believing that an object of kind  $K$ , which you know to be a kind characterized by a certain set of traits  $S$ , should be in a certain region  $r$ , and a  $K$  actually is in that region. You see an object, not of kind  $K$  but characterized by  $S$ , in  $r$ . So you form the belief that an object of kind  $K$  is in  $r$  and this belief is justified by your seeing an object of a kind that is indistinguishable from  $K$  be in  $r$ . Since an object of kind  $K$  actually is in  $r$ , you are both justified in believing that it is in  $r$  and right in believing it. But, intuitively, you don't know that a  $K$  is in  $r$ .

**Example 2:** Sara is a reliable person. She has agreed to show you a crocodile at the zoo. At noon a crocodile is at the zoo and, when you arrive, you see something that looks exactly like a crocodile, and Sara says that it is a crocodile. You form the belief that a crocodile is at the zoo now. As it turns out, what is there is an alligator, something you did not know existed.

The conclusion we can draw from the cases generated according to these schemas is that, even if necessary, conditions (i) – (iii) are not sufficient to constitute an appropriate definition of the concept of knowledge.

## **2. The structure of the Gettier Problems**

The *truthmaker solution* to the Gettier problems depends on a *truthmaker analysis* of the Gettier cases. Thus, before presenting the

truthmaker solution, let us analyse the structure of the Gettier cases. In particular, let us assume that any complete proposition  $\langle p \rangle$  describes a state of affairs and that  $\langle p \rangle$  is true if and only if that state of affairs obtains, so that to know that  $\langle p \rangle$  is true amounts to knowing that the state of affairs represented by  $\langle p \rangle$  obtains.<sup>2</sup> In this simplified version of the truthmaker theory, any true proposition is made true by some state of affairs, specifically by the state of affairs it represents. Now, Gettier cases are cases where we are justified in believing that a state of affairs  $t$  makes  $\langle p \rangle$  true, even if  $\langle p \rangle$  is true in virtue of a different state of affairs. In all such cases we acknowledge that there is a mismatch between the *epistemic basis* making the belief of an agent justified and the *ontic basis* making the believed proposition true. Intuitively, we do not know that  $p$ , because the state of affairs in virtue of which  $\langle p \rangle$  is true is not the state of affairs related to the item in virtue of which we are justified in believing that  $p$ . We would say: “Well, of course the agent lacks knowledge: it is in virtue of an epistemic state  $j$  that she is assuming that  $\langle p \rangle$  is true, whereas it is in virtue of a state of affairs that is completely unrelated to  $j$  that  $\langle p \rangle$  is true”. Just to fix terminology, let us distinguish:

- (1) the *justifier* of  $\langle p \rangle$  = that in virtue of which  $\langle p \rangle$  is justified
- (2) the *justmaker* of  $\langle p \rangle$  = the state of affairs related to the justifier of  $\langle p \rangle$
- (3) the *truthmaker* of  $\langle p \rangle$  = the state of affairs in virtue of which  $\langle p \rangle$  is true.

We can then say that Gettier cases are cases where the truthmaker of  $\langle p \rangle$  is completely unrelated to the justmaker of  $\langle p \rangle$ .<sup>3</sup> In all such cases, even

<sup>2</sup> This assumption can be generalized in many ways. In particular, the requirement of uniqueness of the state of affairs represented by a proposition can be dropped without consequences for the truthmaker solution. See [1] and [7] for general introductions to the truthmaker theory.

<sup>3</sup> A version of this diagnosis is proposed in (Heathcote 2006), p. 165: “In each case, then, we have disjoint states of affairs, one of which is the truthmaker for the statement, the other of which is the state of affairs which is the ground for the justification – this gives us the compass shape for these situations.” A more developed version diagnosis is given in (Giordani, 2013), p. 328 “Indeed, the problem arises because of the combination of four conditions: (1) we possess a justifier for the truth of a certain proposition; (2) such justifier consists in the evidence that a certain state of affairs is actual; (3) such state of affairs is not a

though we are justified in believing that  $p$  and  $\langle p \rangle$  is true, we do not know that  $p$ .

### **3. A partial solution to the Gettier Problems**

According to the previous analysis, the construction of the Gettier cases rests on the lack of relation between the truthmaker of  $\langle p \rangle$  and the justmaker of  $\langle p \rangle$ . Since this is the intuitive diagnosis, the intuitive solution is to introduce a condition according to which the state of affairs that makes  $\langle p \rangle$  true is opportunely related to the justifier that makes the belief that  $\langle p \rangle$  is true justified, i.e. to require that the truthmaker of  $\langle p \rangle$  and the justmaker of  $\langle p \rangle$  be connected. The problem now is to make this intuition precise.

#### **3.1. The Identity Account**

In (Heathcote 2006), an account of knowledge is proposed based on the idea that the state of affairs that makes a proposition true is the same as the state of affairs that the justification is grounded in (see Heathcote 2006, p. 165). In particular, the following definition is stated.

**Identity Account (IA):**  $x$  knows  $p$  if and only if

- (1)  $p$  is true
- (2)  $x$  believes  $p$
- (3)  $x$  is justified in believing  $p$
- (4) the evidence that  $x$  has which constitutes the justification is evidence of the very state of affairs that makes  $\langle p \rangle$  true.

To say that  $j$  is the evidence that constitutes the justification of  $\langle p \rangle$  coincides with saying that  $j$  is the source of the justification of  $\langle p \rangle$ . To say that  $t$  is the truthmaker of  $\langle p \rangle$  coincides with saying that  $t$  is the source of the truth of  $\langle p \rangle$ . Hence, to say that the evidence that constitutes the justification of  $\langle p \rangle$  is evidence of the truth-maker of  $\langle p \rangle$  coincides with saying that the source of the justification of  $\langle p \rangle$  is at the same time evidence of the source of the truth of  $\langle p \rangle$ .<sup>4</sup>

truthmaker for that proposition; (4) we possess no justifier which consists in the evidence that the right state of affairs is actual”.

<sup>4</sup> As highlighted in (Heathcote 2013, p. 3), this account does not imply that the evidence for  $\langle p \rangle$  is infallible. To be sure, a distinction between *evidence for* a

Let “[ $j$ ]p” express the fact that justifier  $j$  is the source of the justification of  $\langle p \rangle$  and “[ $t$ ]p” express the fact that truthmaker  $t$  is the source of the truth of  $\langle p \rangle$ . Then, **IA** can be stated as follow:  $x$  knows  $p$  if and only if  $[j]p \wedge [t]p \wedge j$ -is-of- $t$ , where  $j$  is sufficient for believing  $p$ . **IA** allows us to avoid the problems deriving by the Gettier cases we have presented, since, in all such cases, the identity condition, i.e.,  $j$ -is-of- $t$ , is not satisfied. Indeed, instances of both the Fake Object Schema and the Fake Kind Schema are such that the state of affairs with which our justification is connected is disjointed from the state of affairs that makes the justified proposition true.

### 3.2. Criticism of the Identity Account

In his recent (2014), Vance analyses several truthmaker strategies and argues that all the proposed solutions fail. The general conclusion is that truthmaker strategies seem to be unable to solve the Gettier problems.<sup>5</sup> In particular, with respect to **IA**, Vance argues that the solution does not work, because it is subjected to manifest counter-examples. The counter-examples Vance has in mind are of the following type (see Vance 2014, p. 4).

**Example 3:** Sara is a reliable friend. This is generally acknowledged. You have asked her whether there is a crocodile at the zoo and she tells you that a crocodile is there. So, you form the belief that a crocodile is at the zoo, and indeed it is there.

In a case like this we tend to admit that you have knowledge of the fact that a crocodile is at the zoo. Still, in this case, the state of affairs making the believed proposition true is the crocodile’s being at the zoo, while the state of affairs you have evidence of is Sara’s telling you so. Hence, the truthmaker and the justmaker are different, and so, according to the identity account, you do not have knowledge. **IA**, ruling out the possibility of knowledge based on reliable testimony, conflicts with our intuitions

proposition and *evidence of* a state of affairs can be introduced in such a way that *evidence of* is factive, since it stems from the state of affairs it is evidence of, while *evidence for* is not factive, since it is consistent with many different, and indeed contrary, propositions.

<sup>5</sup> In (2014), Vance also takes into account causal and covariance emendations to **IA**. I agree with Vance that these emendations are not successful in providing an appropriate solution to the Gettier problems.

concerning knowledge from testimony, and so has to be rejected. The conclusion Vance draws is that the proposal we are considering “only delivers a satisfactory account of knowledge in cases of perceptual knowledge, and even then only if the direct realist theory of perception is true. Therefore, sadly, a complete solution to the Gettier problem must be a bit more complicated than this” (see Vance 2014, p. 4).<sup>6</sup>

### **3.3. An ineffective amendment to the Identity Account**

Before going on, let us stress that the foregoing objection cannot be met by simply introducing a distinction between knowledge in a strict sense and knowledge by testimony. In order to see that, let us consider the following general schema.

**Reliable Information Schema:** *S* is generally and justifiably acknowledged as a reliable source of information. You have asked *S* if  $\langle p \rangle$  is true and *S* produces a report  $R(S)$  telling you that  $\langle p \rangle$  is true. So, you form the belief that  $\langle p \rangle$  is true, and indeed it is so. Let us note that

(1) cases of reliable testimony are instances of **RIS** where  
 $S = \text{witness}; R(S) = \text{testimony}.$

(2) cases of reliable recollection, also considered in [8], are instances of **RIS** where  
 $S = \text{memory}; R(S) = \text{recollection}.$

But the most interesting instances of the schema are cases of reliable indication, where

$S = \text{instrument}; R(S) = \text{indication}$

**Example 4:** You know that, typically, if a mercury thermometer indicates that the temperature of a box is 20 °C, then the temperature of the box is 20 °C. You come to know that the thermometer indicates that the temperature of the box is 20 °C. So, you form the belief that the temperature of the box is 20 °C, and indeed it is so.

<sup>6</sup> While **IA** seems to work well when the justification is perceptual, even in case of perceptual knowledge the success of **IA** turns out to be dependent on our theory of perception. In particular, it seems to be inappropriate if indirect realism is true (see Vance 2014, p. 4).

In a case like this we *surely* admit that you have knowledge of the fact in question, since all our empirical knowledge is ultimately based on information provided by instruments, and empirical knowledge is knowledge in a strict sense. Hence, there is no way to bypass Vance's objection by introducing a concept of strict knowledge that bypass **RIS**.

### 3.4. The Ultimate Identity Account

According to **IA**, knowledge is based on the fact that the truthmaker of the justified proposition coincides with the justmaker of that very proposition, where the justmaker of a proposition is the state of affairs *the justification of the proposition is grounded in*. Still, in [4] a slightly different account is proposed, according to which the justmaker of a proposition is the state of affairs *the chain of justifications of the proposition is grounded in*. In particular, the following definition can be stated (see Vance 2014, p. 163).

**Ultimate Identity Account (UIA):**  $x$  knows  $p$  if and only if

- (1)  $p$  is true
- (2)  $x$  believes  $p$
- (3)  $x$  is justified in believing  $p$
- (4) the evidence that  $x$  has which constitutes the justification is ultimately grounded in the very state of affairs that makes  $\langle p \rangle$  true.

This account is further discussed in (Heathcote, 2013), where the analysis of the concept of evidence is developed so to include cases of testimony. To be sure, in (Heathcote, 2013) the justmaker for a proposition  $\langle p \rangle$  is construed as a part of the truthmaker of  $\langle p \rangle$ : an evidential part of the whole. So, suppose Sara is seeing a crocodile at the zoo. Then, Sara's seeing the crocodile is a part of a larger state of affairs including the presence of the crocodile at the zoo, and Sara's telling you about the presence of the crocodile is part of an even larger state of affairs including the presence of the crocodile and Sara's seeing (see Heathcote, 2013, p. 3). Therefore, Sara's seeing the crocodile counts as evidence of the state of affairs that the crocodile is at the zoo and the same is true for Sara's telling you about the presence of the crocodile.

I don't know if the account so sketched can work as a general solution of the Gettier problems, but this description is, as it stands, too generic and



incomplete to be satisfactory, and so an account of the sort of relation between truthmakers and justmakers that is conducive to knowledge is still missing. However, I don't exclude the possibility of interpreting the ultimate identity account in the light of the solution proposed below.

#### **4. A complete solution to the Gettier Problems**

The general framework I want to use in order to solve the Gettier problems is the one proposed in (Giordani 2013). This framework includes a basic truthmaker theory and a theory of explicit and implicit justification. The basic truthmaker theory is characterized (1) by the possibility of composing states of affairs<sup>7</sup> and (2) by a restricted version of the entailment thesis.<sup>8</sup> Indeed, in order to cope with the problems generated by **RIS**, it is sufficient to exploit the core of the theory of explicit justification and the assumption that a truthmaker of  $\langle p \rangle$  also makes true every proposition *logically implied* by  $\langle p \rangle$ . The core of the theory of explicit justification is given by introducing an operation  $\times$  of composition of justifiers and a set of specific justifiers for axiomatic propositions. The theory is then characterized by a schema of axioms **J1** and a schematic rule **RJ**.

$$\mathbf{J1}: [i](\varphi \rightarrow \psi) \wedge [j]\varphi \rightarrow [i \times j]\psi$$

<sup>7</sup> This move is standard in developing a theory of states of affairs. See, for instance, (Armstrong 2004, p. 18), (Heathcote 2013, section 2), and (Read 2000, section 2).

<sup>8</sup> The entailment thesis states that what makes a proposition  $\langle p \rangle$  true makes true every proposition entailed by  $\langle p \rangle$ . This move is less standard. Some truthmaker theorists accept some version of the entailment thesis, see (Armstrong 2004, p. 18) and (Read 2000, section 2), while others prefer to reject it, since it seems to imply that every state of affairs is a truthmaker for every necessary truth. The version of the thesis I'm assuming only implies that every state of affairs is a truthmaker for every logically necessary truth. An argument in defence of this consequence is proposed in (Giordani 2013, section 4), where it is shown that it depends on the assumption of the existence of a unique truthmaker for every logically necessary truth plus the thesis, shared by most truthmaker theorists, that any proposition made true by a state of affairs  $t$  is made true by every states of affairs including  $t$ , see (Armstrong 2004, p. 18), and (Read 2000, section 2). Be it as it may, it is worth noting that the criticism I'm addressing is to the effect that *any* truthmaker theory is defective in solving the Gettier problems. Hence, what is needed is to show that at least one theory is successful in solving them.

**J1** states that, given two justifiers,  $i$  and  $j$ , the composite justifier  $i \times j$  provides justification to any proposition that can be deduced from implications justified by  $i$  and propositions justified by  $j$  by applying *modus ponens*. The idea is that the epistemic agent is able to use the rule of *modus ponens* and that propositional deduction is accepted as providing justification.

**RJ**: if  $\varphi$  is an axiom, then  $[c]\varphi$  is derivable, for some  $c$ .

**RJ** ensures that all the axioms can be justified, i.e. that the epistemic agent is able to use axioms as source of justification. In addition **RJ**, together with **J1**, ensures that all the propositions that are derivable from a finite set of justified premises can be justified. To see that, suppose that  $\varphi$  is derivable from a finite set  $X$  of premises. Then,  $\varphi$  is derivable from the conjunction  $\wedge X$  of the premises in  $X$ . Thus, the implication  $\wedge X \rightarrow \varphi$  is derivable, and so, by **RJ**, there is a justifier  $c$  such that  $[c](\wedge X \rightarrow \varphi)$ . Since all the conjuncts in  $X$  are justified, the conjunction itself is justified, i.e. there is a justifier  $j$  such that  $[j]\wedge X$ . Hence, by **J1**,  $[c \times j]\varphi$ . (see Giordani 2013, section 4, for a detailed proof). That's all we need.

#### 4.1. The Inferential Identity Account

In (Giordani 2013), the basic intuition concerning the truthmaker solution is articulated as follows: if we know that a proposition  $\langle p \rangle$  is true, then we have to be justified in assuming that  $\langle p \rangle$  is made true by a state of affairs  $t$  such that (i) we have access to  $t$  and (ii)  $t$  is an actual truthmaker for  $\langle p \rangle$ . Hence,  $x$  knows  $p$  if and only if  $[j](\mathbf{A}(t) \wedge [t]p) \wedge [t]p$ , for some  $j$  and  $t$ , where  $\mathbf{A}$  is an operator that checks if the epistemic agent has access to the state of affairs  $t$ .

Let us say that we have evidence of  $t$  making true  $\langle p \rangle$  just in case we have a justifier of the fact that we have access to  $t$  and  $t$  makes  $\langle p \rangle$  true. Then, the basic intuition supports the following definition of knowledge.

**Inferential Identity Account (IIA)**:  $x$  knows  $p$  if and only if

- (1)  $p$  is true
- (2)  $x$  believes  $p$
- (3)  $x$  is justified in believing  $p$
- (4) the evidence that  $x$  has which constitutes the justification is evidence of a state of affairs that makes true a proposition from which the truth of

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$\langle p \rangle$  follows.

Indeed, we only have to show that, if we have evidence of a state of affairs that makes true a proposition  $\langle \varphi \rangle$  and the truth of  $\langle p \rangle$  is derivable from the truth of  $\langle \varphi \rangle$ , then we have evidence of a state of affairs that makes true  $\langle p \rangle$ . Suppose

- (i)  $[j](\mathbf{A}(t) \wedge [t]\varphi) \wedge [t]\varphi$
- (ii)  $p$  follows from  $\varphi$ .

Then,  $[t]p$  follows from  $[t]\varphi$ , since any truthmaker for  $\langle \varphi \rangle$  is also a truthmaker for  $\langle p \rangle$ , and so  $\mathbf{A}(t) \wedge [t]p$  follows from  $\mathbf{A}(t) \wedge [t]\varphi$ . Since  $[j](\mathbf{A}(t) \wedge [t]\varphi)$ , we can conclude  $[j^*](\mathbf{A}(t) \wedge [t]p)$ , for an appropriate  $j^*$ , by **RJ** and **J1**. Thus

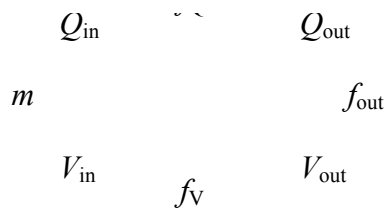
- (iii)  $[j^*](\mathbf{A}(t) \wedge [t]p) \wedge [t]p$ , for an appropriate  $j^*$ .

So, from the evidence of a state of affairs that makes true a proposition  $\langle \varphi \rangle$  and the fact that  $p$  follows from  $\varphi$ , we obtain the evidence of a state of affairs that makes true the proposition  $\langle p \rangle$  (See Giordani, 2013, end of section 5, for a detailed proof).

*Remark:* **IIA** can be considered a version of **UIA**. However, the interpretation of **UIA** given in (Heathcote, 2013) is different from **IIA**. To be sure, the idea proposed in (Heathcote, 2013) is that of introducing a chain of states of affairs, ordered by a relation of being part, linking the state of affairs to which we have access to the state of affairs that makes the known proposition true. By contrast, the idea underlying **IIA** is that of introducing a chain of propositions, ordered by a relation of derivability, linking the known proposition to the proposition made true by the state of affairs that we have access to.

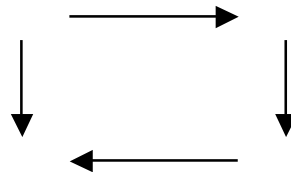
#### **4.2. The solution to the cases of reliable indication**

In order to see why **IIA** allows us to get a solution to the cases proposed in section 3, let us move back to the case of our reliable thermometer. A thermometer is a measurement instrument and the core component of a measurement instrument is a device which typically operates by transducing the quantity being measured,  $q_{in}$ , to an output quantity,  $q_{out}$ .



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This process is modelled by a function  $f_Q: Q_{in} \rightarrow Q_{out}$ , where  $Q_{in}$  is a set of admissible input quantities and  $Q_{out}$  is a set of admissible output quantities. Two points are worth noting. On the one hand, a transducer is designed in such a way that the output quantity that it produces is discernible, so that each output quantity can be mapped to a quantity value in a set  $V_{out}$  of output quantity values. This process is modelled by a function  $f_{out}: Q_{out} \rightarrow V_{out}$ . On the other hand, a relation between output quantity values and values in a set  $V_{in}$  of input quantity values is given by inverting the fundamental operation of calibration. This process is modelled by a function  $f_V: V_{out} \rightarrow V_{in}$ . In picture:



The measurement function  $m$  is then obtained by composing  $f_Q$ ,  $f_{out}$ ,  $f_V$ .<sup>9</sup>This model highlights that we can assume that the information we get at the end of the measurement process is accurate only on the base of a number of assumptions. In particular, we have to assume that  $f_Q$  is an appropriate model of the transducing process, that  $f_{out}$  is an appropriate indication process, and that the instrument is correctly calibrated. If these assumption are justified, then we are also justified in believing that

- (1) if  $q_{in}$  is the input quantity, then  $q_{out} = f_Q(q_{in})$  is the output quantity
- (2) if  $q_{out}$  is the output quantity, then  $v_{out} = f_{out} \cdot f_Q(q_{in})$  is the output value
- (3) if  $v_{out}$  is the output value, then  $v_{in} = f_V \cdot f_{out} \cdot f_Q(q_{in})$  is the input value

<sup>9</sup> In our case, the input quantity is given by the temperature of the box and the output quantity is given by the length of the mercury column. The function  $f_Q$  used to model the relation between  $Q_{in}$  and  $Q_{out}$  is typically a linear function. Furthermore, the output quantity value is given by the mark of the graduated scale of the thermometer and the function  $f_{out}$  is defined by the correspondence between highest points of the mercury column and marks on the scale. Finally, the output quantity value, once a temperature scale is defined, is given by the number represented by the numeral associated to the mark of the graduated scale, and the function  $f_V$  is defined by the correspondence between marks and numbers.

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Finally, if (1) – (3) are justified, we are also justified in believing that

(4)  $v_{in} = m(q_{in}) = f_v(f_{out}(f_Q(q_{in})))$  is the temperature of the box.

What we learn from this analysis is that, in a case of reliable indication, the truth and the justification of a proposition like (4) are based on the truth and the justification of (1) – (3). Hence, the knowledge of (4), being based on the knowledge of (1) – (3), actually is a case of inferential knowledge, perfectly consistent with **IIA**. Here, the conjunction of propositions (1) – (3) plays the role of  $\langle \varphi \rangle$ , while (4) plays the role of  $\langle p \rangle$ .

### **4.3. The solution to the cases of reliable testimony**

A case of reliable testimony is wholly analogous to a case of reliable indication. The analogy rests on the possibility of interpreting a witness as something similar to an instrument. Let us consider the following assumptions:

**Assumption1:** you are justified in believing that Sara told you that  $p$ .

**Assumption2:** you are justified in believing that Sara's report is reliable.

These assumptions are either explicitly or implicitly stated in the story. To be sure, if you had reasons for suspecting that Sara's testimony is unreliable, or that Sara is telling you something she has no knowledge of, or that you have misunderstood what Sara told you, you probably would suspend your belief. But from the previous premises the following inference can be drawn (where (1) follows from the definition of reliable report):

(1) you know that, if Sara's report is reliable, then its content is true

(2) you are justified in believing that Sara's report is reliable

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(3) you are justified in believing that the content of the report is true

(4) you are justified in believing that the content of the report is  $\langle p \rangle$

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(5) you are justified in believing that  $\langle p \rangle$  is true

Hence, instances of reliable testimony are cases of inferential

knowledge, and cases of inferential knowledge are captured by **IIA**.

## 5. Conclusion

The objection by Vance against the **IA** version of the truthmaker solution to the Gettier problems is based on intuitive counter-examples to it. These examples are cases of a general schema, the Reliable Information Schema, and cannot be avoided by contrasting a concept of strict knowledge with a concept of knowledge by testimony. Still, the account proposed in (Giordani 2013) allows us to introduce a version of the truthmaker solution, **IIA**, that is immune to the instances of the Reliable Information Schema. Since **IIA** is also able to provide a solution to the Gettier problems, it seems that the intuition underlying the truthmaker solution has received an appropriate characterization.

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