

University of Tartu

Institute of Philosophy and Semiotics

**THE LOGIC OF KNOWLEDGE AND DEMONSTRATIVES**

Master's Thesis in Philosophy

Nikolai Shurakov

Supervisors:

D.Phill. Juhani Yli-Vakkuri

Ph.D. Patrick William Shirreff

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I have written this Master's Thesis myself, independently. All of the other author's texts, viewpoints and all data from other sources have been referred to.

Author: *Nikolai Shurakov*

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I permit this thesis to be defended.

Supervisors:

*D.Phil. Juhani Yli-Vakkuri*

*Ph.D. Patrick William Shirreff*

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## Introduction

It is possible in principle to argue that philosophy and its method have no progress. For example, you might characterize philosophy “as a series of footnotes to Plato”<sup>1</sup> and argue that there is no progress in philosophy since Ancient Greek thought. However, there is another position according to which there exists progress in philosophy and we can reach it by applying the existing method carefully or change the method to the more fruitful one. This thought is echoing T. Williamson’s statement from *Philosophy of Philosophy* (2007:7):

[S]mall improvements in accepted standards of reasoning may enable the philosophical community to reach knowledgeable agreement on the status of many more arguments.

Development of tools we can use in our reasoning is one of the key missions of philosophy nowadays. If we are not satisfied with the formal methods we have, then we have to improve them. In this way, one can view my thesis as an improvement of the existing formal methodology of dealing with expressions containing indexicals.

Indexicals are expressions whose meaning depends on the context. In the context of this thesis an indexical ‘I’ denotes me, the author of the thesis and another indexical ‘you’ denotes a reader of it. Indexicals like ‘now’ or ‘here’ require even more context. If I write ‘It is dark here now’ then in order to understand what I communicated you need to know that I am in my room in Tartu and that it is 11 p.m. on the 4<sup>th</sup> of August 2020. The context helps us to find out that I wrote the truth. In that way, the meaning of indexicals is connected with the context. When we talk with each other we always do it in some context. Thus, we use tons of indexicals every day, and that makes a topic of indexicals so important. All the following examples illustrate it (indexicals are the words in the single quotation marks): We refer to ourselves and our addressees using ‘I’ and ‘You’. We recall something that was ‘yesterday’ and dream about ‘tomorrow’. We ask a seller to give us ‘this’ apple and don’t want to go to ‘that’ overpriced bar again.

<sup>1</sup> Whitehead, A. (1979) *Process and Reality*, p.39

In the philosophy of language, David Kaplan's *Logic of Demonstratives* (hereafter just LD) is widely regarded as the best formal approach to the indexicals. In the first section of my thesis, I will be describing the main idea(s) that can be found within Kaplan's LD. The key feature of this system is that it is two-dimensional i.e. there are two worlds with respect to which a given sentence is evaluated. The first dimension is the context and the second is the circumstances of evaluation.

In the second section, I will discuss some of the difficulties that occur for the formal apparatus within LD when the epistemic operator K ('it is known that') is added. I present several surprising conclusions that result from adding K using LD's standard semantics. This leads us to the problem I am trying to solve: *Is it possible to add K to LD without doing violence to the standard informal interpretation of K? If yes, then how?*

If the standard semantics for K is of no help for us, then we need to replace it with an adequate one. In the third section, I examine one possible solution. It is to make use of an interpretation presented in the article written by Rabinowicz and Segerberg (1994). In it, they gave a two-dimensional approach to the epistemic operator and introduced an "E-relation" that was originally intended to avoid Fitch's paradox. While not its original or intended use, this E-relation can be made to be relevant to the current discussion of the issues LD has with K. From here, I argue that the modification of Rabinowicz and Segerberg's is plausible. This solution allows us to stay within the same two-dimensional framework found in LD and avoids the problems posted in section two. Therefore, I conclude that we should expand LD with K using Rabinowicz and Segerberg's approach.

Introducing the knowledge operator to LD may allow us to deal with more truths and probably to get some other theoretically interesting conclusions. It will let us proceed to sentences like 'It is known that I am here now'. It is quite natural to ask the next question: Known for whom? This leads us to the question of the epistemic agent **a** and to the more complex epistemic operator **K<sub>a</sub>** ('it is known for an agent a that'). The thesis makes the first step towards such an operator. Consequently, it may become the base for some further research. For now, I am

only focusing on the technical details how the epistemic operator might be introduced to the LD.

### Preliminary remarks

To start off, it is important for the reader to be on the same page as myself. This thesis crucially deals with context-sensitive elements and, thus, it is useful to assume a shared context for the reader and me. We will do this by assuming that we are in Tartu, at noon on the 13th of July, and that 'I' uniquely denotes Nikolai Shurakov.

Secondly, I will assume that we understand the meaning of words such as 'now' and 'here'. We do not need to speculate about this but I do not deny that there is a giant room for such speculations in metaphysics. I suggest to take these words as follows: 'now' refers to a minute time period and 'here' refers to at least one square meter sized piece of space. These assumptions do not directly affect my argument and are needed only for better representation of my ideas.

Thirdly, there is a conflict in the notation used by the different authors. My work is mainly based on the *Demonstratives*, so I chose to use 'A' for the actuality operator. Kaplan used it in this way and I follow him. However, in some papers that I will cite, the actuality operator is denoted using a symbol '@'. Throughout the thesis, I will stick with one style, hence I will substitute uses of '@' to 'A' throughout the remainder of this thesis. Due to this, there may be occasions where my citation differs slightly from the original text but I prefer to be consistent and use one style of notation throughout the thesis to prevent possible misunderstandings.

## **1. *Logic of Demonstratives* and motivations for it**

This expository section aims to acquaint a reader with LD. I will begin with an explanation of the motives for introducing LD. I will then, present the language and the main features found within this system.

First off, I will go into more detail as to what indexicals are than what I provided in the introduction of this thesis. Crucially, indexicals are context-sensitive expressions; that is, the meaning of indexicals vary from one context to another. If you and I say ‘I am the author of this thesis’ the indexical ‘I’ refers to me in one case and to you in another. This difference affects even the truth-value of an expressed proposition. In the former context, I would be telling the truth whereas in the latter you would be lying. The very same sentence that contains an indexical (or indexicals) expresses different propositions with respect to different contexts. In addition to ‘I’, Kaplan (1989:489) mentions other examples of indexicals such as the pronouns ‘my’, ‘you’, ‘he’, ‘his’, ‘she’, ‘it’, the demonstrative pronouns ‘that’ and ‘this’, the adverbs ‘here’, ‘now’, ‘today’, ‘tomorrow’, ‘yesterday’, along with the adjectives ‘actual’ and ‘present’.

Kaplan (1989:490) calls some of them *demonstratives*. That’s the reason why his formal system called *the Logic of Demonstratives*. Demonstratives work differently from the other indexicals in that the meaning of such words is incomplete without an additional demonstration. For example, I could say to a waiter ‘I would like to have *this* bottle of wine’. In this example, the waiter would not be able to understand me if I wasn’t pointing to some bottle of wine. As this example illustrates ‘this’ is an example of a demonstrative. Throughout his work, Kaplan also singles out a group of indexicals that he calls *pure indexicals*. Examples of pure indexicals include: ‘I’, ‘now’, ‘here’, ‘tomorrow’ and others for which “no associated demonstration is required, and any demonstration supplied is either for emphasis or is irrelevant (Kaplan 1989:491)”. I will not argue that Kaplan’s list of indexicals is complete or that it is the only way to deal with indexicals. Rather, I am taking his way of thinking about and treating indexicals as a basic assumption that will define which words we should consider as indexicals for the purposes of this paper.

Let's assume that we are talking about the actual world **w** in which I utter the following two sentences:

(1) I am here now.

(2) Nikolai Shurakov is in Tartu, at noon on the 13th of July.

Before Kaplan, there was an approach to indexicals that stated that (1) expresses the same proposition as (2) when uttered in given circumstances. Kaplan (1979:81) considers this approach at the very beginning of his article:

It has been thought by some - myself among others - that by analogy, the intension of 'I' could be represented by a function from speakers to individuals (in fact, the identity function). And similarly, that the intensions of 'here' and 'now' would be represented by (identity) functions on places and times.

This view is called **Index Theory** and is discussed by Kaplan in section VII of *Demonstratives*. According to Index Theory, if we take some proper indices, such as **a** for an agent, **p** for a place, and **t** for a time, then we may find out that (1) is true when **a**=Nikolai Shurakov, **p**=Tartu, and **t**=noon of the 13th of July. If so, (1) is saying precisely the same as (2). Hence, both sentences are two ways of expressing one and the same proposition. However, there are many quadruples of the world, agent place and time (a set  $\langle w, a, p, t \rangle$ ) such that a sentence constructed using the following schema '[at **w**] Agent **a** is in place **p** at time **t**' is false. For example, one such false quadruple would be: the actual world, Nikolai, Darovskoy, the 13th of July 2020. Index theory simply identifies (1) with the schema.

Kaplan argues that this approach is not correct. He noticed that Index theory takes into account only one dimension that is not enough to capture the difference between (1) and (2). According to Kaplan, (1) is just a sentence that if uttered, or just thought, could not be false. No matter who said (1) at whatever time they said it, he or she will always tell the truth. If (1) was identical to the schema we will have many false instances of it. But when (1) is expressed there are always speaker, time and place, so (1) is true for every context. It makes (1) a logical truth (at least for Kaplan). In contrast, there are many false instances of the schema '[at **w**] Agent **a**

is in place  $\mathbf{p}$  at time  $\mathbf{t}$ '. Therefore, Index theory fails to capture the real nature of (1).

Furthermore, if (1) is treated as a logical truth, it becomes a counterexample to the principle of modal generalization (or 'necessitation'):

**if  $\vDash \varphi$  then  $\vDash \Box \varphi$**

This principle says that every logical truth is also a necessary truth. Since (1) is a logical truth, (1) must be a necessary truth as well. But of course, it is contingent that I am in Tartu, at noon on the 13th of July. I could be in Russia, if there were no movement restrictions due to COVID-19 outbreak, or I could have been dead due to some contingent accident. There are many cases when (1) is expressing a contingent claim. Suppose that someone kidnapped me and put me in a car trunk. I would have no idea where am I and what time it will be at any moment but if I were to whisper 'I am here now' I would still be saying the truth. But it is completely contingent that I am here now. Thus, (1) is not only a logical truth but also a contingent truth.

In my view, two of the motivations for Kaplan's LD were the failure of the Index theory to explain why (1) is the logical truth and the rejection of the principle of modal generalization. Moreover, Kaplan realizes that Hans Kamp's work on 'now' where Kamp demonstrates that double indexing is required for dealing with temporal indexicals<sup>2</sup> foreshadowed LD. Kaplan, therefore, came to the conclusion that we need double indexing to deal with indexicals. The first indexing is based on the context and the second is based on the circumstances of evaluation, which I will now go on to explain.

The crucial role in LD is played by the difference between the content and the character. The content is "what is said" and traditionally been called a proposition. It is either true or false with respect to the circumstances of evaluation. Kaplan considers the content not only of sentences but also of definite descriptions, indexicals, predicates, etc In these cases, it finds an extension of a given expression.

<sup>2</sup> Kamp, H. (1971). Formal Properties of 'Now'

The content is an output of a function called the character. The character of an expression is set by linguistic conventions. It is fixed in case of sentences without any indexicals. But if a sentence contains an indexical expression then the character determines the content of it by filling the meaning of indexical with a relevant part of the context.

According to Kaplan, when we encounter a sentence with an indexical expression, we go through a two-step process. First, we find the meaning of the indexical (or indexicals) from the context of utterance. This is done using the character of the expression, which is as a function from context to content. For example, the character of 'I' will usually provide as an output the speaker of the context as a referent. In the second step of the process, we consider the content of a given sentence. The content will be a proposition and it is by using this proposition that we can determine a truth-value. As a result, we are able to say whether a sentence that contains an indexical(s) is true or false.

Coming back to our original example, (2) has a fixed character and content. However, the content of (1) varies from one context to another, so its character isn't a constant function. (2) "skips" the first step of the process above and goes directly to the true/false evaluation. However, the character of (1) means that we must first find out what proposition is expressed and only then we can evaluate the sentence. In this way, LD allows us to see the difference between (1) and (2).

The LD system is defined in part XVIII "The Formal System" (Kaplan, 1989:541-546). For now, I will only describe some key features of it. LD is based on first-order predicate logic with two sorts of variables, variables for positions and variables for individuals. It also includes modal operators for possibility  $\diamond$  and for necessity  $\square$ , tense operators **F** (it will be the case), **P** (it has been the case that), **G** (one day ago, it was the case that), 1-place sentential operators **N** (now), **A** (it is actually the case), **Y** (yesterday, it has been the case), functor *dthat*, individual constant **I** and position constant *Here*.

This formal system is enough to provide in addition to (1) some other examples of contingent a priori truths. Kaplan's examples include

- i. **N (Located(I, Here))** (I am here now)
- ii. **Exists (I)** (I exist)
- iii.  $\varphi \leftrightarrow \mathbf{AN}\varphi$  ( $\varphi$  if and only if now it is actually the case that  $\varphi$ )
- iv.  $\alpha = \mathbf{dthat}[\alpha]$

We have already seen why (i) is a contingent logical truth. (ii) is saying that our existence is contingent. Each of us could simply not be born or be born at some other time. The fact of our existence is contingent, according to Kaplan and LD. (iii) is a bit tricky. We know that ‘Tallinn is the capital of Estonia’. It is a contingent truth about the actual world. As it happens in the actual world then It is actually the case that Tallinn is the capital of Estonia. And as it happens now we can add N to get ‘It is actually the case that now Tallinn is the capital of Estonia’. We just saw that one part of biconditional is true. It seems to be obvious that if something is actually the case now then it is true. Thus, (iii) is a logical truth. But if  $\varphi$  is a contingent truth such as in case of the capital of Estonia then (iii) is not necessary.

To understand the meaning of (iv) some extra explanation is required. **dthat** is a special functor that allows treating any description or singular term as directly referential. For example, ‘dthat [the author of this thesis]’ directly refers to me. Kaplan uses ‘dthat’ to solve Frege puzzle that is formulated in Kaplanian terms as follows (Kaplan, 1989:529): “How can ‘dthat[a]=dthat[b]’ if true, differ in cognitive significance from ‘dthat[a]=dthat[b]’?”. Continue with the previous example we can have the following instance of Frege puzzle:

(D1)  $\mathbf{dthat} [\text{the author of this thesis}] = \mathbf{dthat} [\text{Nikolai Shurakov}]$

(D2)  $\mathbf{dthat} [\text{Nikolai Shurakov}] = \mathbf{dthat} [\text{Nikolai Shurakov}]$

Both (D1) and (D2) are true and have the same content; that is, both express an identity statement about me. Kaplan says that (D1) and (D2) have the same content but differ in the character. He identifies the character with the cognitive significance of thought. Then, (D1) and (D2) differ in character and we can see Kaplan’s solution of the Frege Puzzle. This solution is not so far from the Fregean original solution based on the distinction between the sense and the reference.

Back to the above example, (iv) might be illustrated by a famous example from Kripke<sup>3</sup>. Suppose that  $\alpha$  is 'one meter'.

**'One meter' = dthat (the length of S at time  $t_0$ )**

'One meter' could rigidly refer to the length of the stick that was chosen to be a standard meter. As Kripke argues, the stick might be longer or shorter in some possible world due to some external factors like temperature. Hence, this sentence is a contingent a priori truth as well. As a result, we have even more arguments to agree with Kaplan that the principle of modal generalization is false.

To sum up, LD is a two dimensional system with many operators that allows to deal with sentences which contain indexical expression(s). However, while we have so many operators in LD, we do not have any epistemic operators in this complex system. Is it possible to add one? This is the questions that I will attempt to answer. I will consider both standard and non-standard interpretations of the epistemic operator K and argue in favor of one of them in the following sections.

<sup>3</sup> Kripke, S. (1980). Naming and Necessity, pp.53-57.

## 2. LD and standard interpretation of the epistemic operator

There is no need to emphasize the significance of knowledge in our life. But we usually think of knowledge as something that does not change through the passage of time. In contrast, the meaning of indexicals vary from one context to another. One might think that it is impossible to have a formal system such that combined both indexicals and knowledge. I argue that we can have such a system. We have already seen LD as a formal system to deal with indexicals. Epistemic logic is a formal way to deal with knowledge. A core of epistemic logic is the presence of an epistemic operator K ('it is known that'). This operator can be further advanced by adding an agent who poses the knowledge but I am leaving it as a possibility for some later research. In this section, I introduce K to LD using its standard definition and argue that this combination does lead to some weird conclusions.

Let's see what will happen if we add an epistemic K-operator such that:

**$K\chi$  is true at  $w, e, M$  iff for all  $u$  such that  $eRu, \chi$  is true at  $w, u, M$**

( $\chi$  is known in some epistemic possibility iff  $\chi$  is true in every epistemic possibility relevantly accessible from  $e$ .  $M$  is used for a Model. By epistemic possibility I mean a possible world that may exist for all we know).

This definition I am calling a standard definition because it is used widely as a starting point of a modal interpretation of knowledge<sup>4</sup>.

The definition of an actuality operator  $A$  in LD is just:

**$A\phi$  is true at  $w, v, M$  iff  $\phi$  is true at  $w, w, M$  where  $w$  is the actual world**

(It means that a proposition that is said to be actually true is true in the world taken as an actual world).

<sup>4</sup> Sider, T. (2010). Logic for Philosophy, p.237; Rabinowicz, W. and Segerberg, K. (1994) use a similar definition and call it standard.

We know that  $\varphi \leftrightarrow A\varphi$  is a logical truth in LD because it is a logical consequence of (iii) $\varphi \leftrightarrow AN\varphi$ . So, we can put  $\varphi \leftrightarrow A\varphi$  to the place of  $\chi$  in the definition of K.

**K( $\varphi \leftrightarrow A\varphi$ ) is true at w, e, M iff for all u such that eRu,  $\varphi \leftrightarrow A\varphi$  is true at w,u, M**

By definition of K, it is known that  $\varphi \leftrightarrow A\varphi$  if and only if for all epistemically accessible possible worlds  $\varphi \leftrightarrow A\varphi$  is true.

Then we consider a set of propositions about the actual world. Any proposition  $\pi$  is either actually true or its negation is actually true.  $\varphi \leftrightarrow A\varphi$  allows us to omit the actuality condition and we can say that any proposition  $\pi$  or its negation is true for all epistemically possible worlds u. That's why we can define  $\psi$  in the following way:

**$\psi = \pi$  if  $\pi$  is true or  $\psi = \neg\pi$  if  $\neg\pi$  is true**

As a result, we get the following:

**$\psi$  is true for all u such that eRu**

All possible interpretations of  $\psi$  are truths for all accessible u. This simply means by definition of knowledge operator that it is known that  $\psi$ . In other words, **K $\psi$**  is the case.

Consequently, we have (K+A) that summarizes what we observed so far:

**(K+A)                      K( $\varphi \leftrightarrow A\varphi$ )  $\rightarrow$  ( $\psi \rightarrow K\psi$ )**

We had no extra conditions on possible worlds w,e or u. It makes (K+A) to be valid in the system composed by LD and standard definition of K. In my view, (K+A) leads to some weird conclusions.

The first surprising conclusion of (K+A) is that we must know all the truths. The only assumption about  $\psi$  was that it is true, and as a result, it is known. It reminds a conclusion similar to Fitch's paradox of knowability inside the system:

if it is known that  $(\varphi \leftrightarrow A\varphi)$ , then everything is known. There are at least several problems I can deduct from this.

Firstly, we need to know the content of  $\psi$ . Suppose that  $\psi$  is the statement by my great-( ... )-grandson about the weather on the 13th of July in 3020. He told the truth. If  $(K+A)$  is acceptable, then we already must know that  $\psi$ . But we have no idea of the content of this proposition. It is not true because of its form. It is not an instance of the law of excluded middle  $\psi \vee \neg\psi$ , for example. But somehow it must be known. In my opinion, it is a problem for a system.

Secondly,  $(K+A)$  also leads to another kind of absurd conclusion. We know that  $\varphi \leftrightarrow A\varphi$ . Suppose  $\varphi$  is a true contingent statement about the actual world, and we know that it is contingent. In that case,  $A\varphi$  comes out as true in any world because it gets its truth-value from the actual world. Also, we know that  $A\varphi \rightarrow \varphi$  as a part of the biconditional that we know. From the knowledge of contingency, we can think about a possible world  $u$  such that  $\varphi$  is not the case in  $u$ .  $A\varphi$  and  $A\varphi \rightarrow \varphi$  are true in  $u$ . By *Modus Ponens*, we must know that  $\varphi$  is the case in  $u$ . As a result, we get a proposition of the same kind as a claim about Schrödinger's cat: we know that  $\varphi$  in  $u$ , and we know that  $\varphi$  is not the case in  $u$ .

Furthermore, we will be in a more troublesome situation if we add an epistemic agent and want to interpret  $K$  as 'it is known for an agent  $\mathbf{a}$  that'. Any (under)graduate philosophy student know that  $\varphi \leftrightarrow A\varphi$  (for example, after reading *Demonstratives*). One of these students knows that  $\varphi \leftrightarrow A\varphi$ . Thus, the antecedent of  $(K+A)$  is true for her, and she can come to the conclusion that if there exists some truth  $\psi$  then it must be known by her -  $K\psi$ . She is omniscient. As a result, any such a student must know everything. It might be such a wonderful world to live in if just one book provides you with a key to omniscience. But it is obviously not the case in the actual world.

We have combined the standard interpretation of  $K$  with just  $\varphi \leftrightarrow A\varphi$ , but we could do the same using  $\varphi \leftrightarrow AN\varphi$ . It would lead to even more implausible claims about our current state of affairs. For example, we know that  $\varphi \leftrightarrow AN\varphi$ , and

therefore, we know everything now even the truth-value of something said by my great-( ... )-grandson in 3020. That is an unwanted result.

To sum up, adding K-operator to LD generates several problems. First is that we must know the truth-value of any proposition, even those proposition that are completely unknown to us right now or even potentially always unknown to us. The second is that a combination of K-operator and theorem  $\phi \leftrightarrow A\phi$  results in a paradoxical statement that we know and don't know some  $\phi$  simultaneously. We also might face difficulty trying to add an agential or a temporal aspect in our reasoning. Therefore, I argue that LD is inconsistent with the given standard interpretation of epistemic operator K.

I think that this problem is caused by the lack of discrimination between epistemically accessible possible worlds and between metaphysically accessible worlds. The actuality operator A depends on the world that is taken as an actual. If it is actually the case that  $\psi$  in the actual world then  $A\psi$  is true in any other metaphysically possible world i.e. in any possibility that is "allowed by the natures of all of the things that could have existed"<sup>5</sup>. The set of epistemic possibilities is narrower. Hence, not every metaphysical possibility is also an epistemic possibility. It might be the case that something is actually true but we do not know it. Therefore, we cannot access some epistemic possibility based on this unknown truth. At the same time, (iii) $\phi \leftrightarrow AN\phi$  allows us to push through any metaphysically possible truth to the scope of the epistemic operator K. It makes the unknown actual truth to be true for all epistemically accessible worlds that means that it becomes known. To avoid this contradiction, we need to differentiate the scopes of actuality operator A and epistemic operator K. In the next section, I will present an approach that makes this distinction.

<sup>5</sup> Vaidya, A. (2017) The Epistemology of Modality, *The Stanford Encyclopedia of Philosophy*.

### 3. How to add the epistemic operator to LD?

We noticed that we had troubles because we did not distinguish between epistemic and metaphysical possibilities. Consequently, we should try to find a semantics that makes this distinction. To do this, we will be using resources found with the work done by Rabinowicz and Segerberg in “Actual Truth, Possible Knowledge”.

In their article, they are focused on trying to avoid Fitch’s paradox, which was similar to one of the problems we faced dealing with the standard interpretations of the epistemic operator. Their starting point is Edington’s formulation of verificationism i.e. an idea that truth implies knowability. Edington (1985) provided a formulation of a verificationist claim that seems to be good enough to avoid Fitch paradox:

$$\mathbf{A}\psi \rightarrow \diamond \mathbf{K}\mathbf{A}\psi^6$$

It means that it is possible to know the actual truths. If something is true in the actual world, then it is possible to know it. But it does not mean omniscience because something might actually be the case but be unknown. It is conceivable that something happened but nobody noticed it and the claim about this event is unknown. Edington’s formulation of verificationism is consistent with such cases. The Fitch paradox does not arise.

However, Rabinowich and Segerberg decided to combine Edington’s formulation of verificationism with standard interpretations of necessity operator  $\square$  and epistemic operator K. It resulted in the claim (Rabinowich and Segerberg, 1994:104): “[W]hatever happens to be true is known to be actually true.”

It is almost the same claim as a consequent of (K+A). In that way, Rabinowicz and Segerberg faced the same problem of combining the actuality operator with the epistemic operator.

<sup>6</sup> Edington, D. (1985). The Paradox of Knowability, p. 567; Rabinowicz, W. and Segerberg, K. (1994). Actual truth, possible knowledge, p.102.

To solve the problem, they introduce another interpretation for K-operator. They take a two-dimensional logic, but they call the first dimension - *perspective* (or point of perspective), and another dimension is called *reference world*.

If we try to combine it with Kaplan's LD, then we should treat dimensions in the following way: the reference world is a world of evaluation (circumstances of evaluation), and a variable perspective is just a Kaplanian context. In my view, this interpretation is not far from Kaplan's original intentions about double indexing in circumstances of evaluation and the context. The key difference is that the modal operators are classified as fixed perspective (necessity operator  $\Box$  and actuality operator A) or as a variable-perspective operator (epistemic operator K). In the case of epistemic possibilities, we can have not only different contexts but also different circumstances of evaluation (in Kaplanian terms). Suppose that some event EVENT has happened in the actual world. Hence, it is true that the event has happened. In the case of actuality operator, we have a fixed perspective and when we look at the circumstances of evaluation we can only get that A(EVENT) is true. However, there are different options with respect to epistemic context. It is possible that EVENT has happened but no one knows about it. We have two varieties of circumstances of evaluation - the first is such that K(EVENT) [it is known that event has happened] and the second is such that  $\neg$ K(EVENT) [it is not known that event has happened]. The variable-perspective provides these options.

Then, let's try to combine LD and the approach defended by Rabinowicz and Segerberg, the interpretation of the epistemic operator is (Rabinowicz and Segerberg, 1994:105):

**K $\phi$  at w,v, M iff ' $\phi$ ' is true at every w' and v' such that  $\langle w,v \rangle \in E \langle w',v' \rangle$**

where E is a special epistemic relation between the states. As we know, Rabinowicz and Segerberg differentiate between fixed-perspective and variable-perspective. To allow the variation in perspective they introduce E-relation that plays a crucial role in the definition of the epistemic operator. As we have a two-

dimensional system we have two sources of epistemic uncertainty - two worlds. That's why we have both  $w'$  and  $v'$  in the definition of  $K$ . Moreover,  $E$  is not a relation between worlds but between states. Rabinowicz and Segerberg define states as ordered pairs of world. States in which reference and perspective worlds coincide (ordered pair  $\langle w, w \rangle$  is an example) called self-centered. So, we have a set of states that includes a set of self-centered states. With respect to these sets, Rabinowicz and Segerberg define two types of validity in this system<sup>7</sup>:

**$\phi$  is weakly valid if and only if  $\phi$  is true in any state  $u$  such that  $u$  is self-centered**

**$\phi$  is strongly valid if and only if  $\phi$  is true in any state  $u$**

What will happen with  $(K+A)$  if we add  $K$  to LD using the definition of  $K$  given above?

$K(\phi \leftrightarrow A\phi) \rightarrow (\psi \rightarrow K\psi)$  must be true with respect to  $\langle w, w \rangle \in \langle w', w' \rangle$  to be weakly valid. However, the move  $\phi \rightarrow K\phi$  is problematic because  $E$  allows different perspectives. It might be the case that  $\phi$  is true but there are different perspectives  $w$  and  $w'$  such that  $\phi$  is or isn't known for  $w$  and  $w'$  respectively.

I will illustrate it with an example. Suppose, I say 'There are two books on my table'. It could be more or fewer books in some other possible worlds but there are just two in the actual world. Epistemic operator  $K$  is variable-perspective operator, so there are at least two perspectives from which we know or don't know that there are two books on my table. Metaphorically speaking, if you are in my room there is a perspective which allows you to verify my claim, and if you are not in Tartu then your perspective does not allow you to know whether I have a couple of books on my table or not. These different perspectives are simply  $w$  and  $w'$ . As a result, any case of contingent truth  $\psi$  will be similar to my example:  $\psi$  is true at  $w$  but might be false at  $w'$ . There might be a perspective such that  $\psi$  is true but it is not known that  $\psi - \neg K\psi$ . Hence, there are cases when  $K\psi$  is not implied by  $\psi$ . Therefore,  $(K+A)$  might have true antecedents but false consequent. That means it

<sup>7</sup> Rabinowicz, W. and Segerberg, K. (1994). Actual truth, possible knowledge, p.104.

cannot be weakly valid. As it is not valid for self-centered states it cannot be valid for all states. Therefore, (K+A) is not strongly valid as well. If so, (K+A) is not able to cause the problems from the second section, and we can combine LD with the ideas of Rabinowicz and Segerberg.

To conclude, I claim that LD might be expanded by adding epistemic operator K using Rabinowicz and Segerberg's approach. Their interpretation of two-dimensions, I think, is in accord with the spirit of Kaplan. Two-dimensional interpretation for K might be directly introduced to LD. Let's call this logic *The Logic of Knowledge and Demonstratives* (or simply LD+K).

This logic will be capable with processing sentences like 'It is known that I am here now'. The first step is taking the meaning from the context of utterance to get a proposition. Then, this proposition is to be evaluated with respect to epistemic possibilities. This sentence could not be proceeded by the original system LD but could be proceeded by LD+K. It is the small but improvement of the method we had. Maybe, it is some step towards the progress in philosophy.

## Conclusion

My thesis aims to demonstrate how an epistemic operator  $K$  can be added to the Logic of Demonstratives. I started with a description of Kaplan's LD. Firstly, I showed that Index Theory was not good enough to capture an idea that 'I am here now' is a logical truth. Secondly, if 'I am here now' is a logical truth then the principle of modal generalization (that states that all logical truths are necessary) is false. Indeed, it is usually contingent that I am here now. In my view, these two reasons motivated Kaplan to create the formal system LD. There are several contingent logical truths in LD but one of them  $\phi \leftrightarrow A\phi$  played a crucial role in my further reasoning.

In the second section of the thesis, I tried to add the epistemic operator  $K$  to the LD using its standard definition. As a result, I got a formula  $(K+A)$  that, in my opinion, leads to a number of weird results. If it is known that  $\phi \leftrightarrow A\phi$  then every truth is known. This problem reminded me of the Fitch paradox of knowability. That's why I was looking for an interpretation of epistemic operator that avoids this paradox.

I found an article of Rabinowicz and Segerberg(1994) that provides the non-standard interpretation of epistemic operator  $K$ . They consider necessity and actuality operators as ones with a fixed perspective and allow  $K$  to have a variable perspective. As a result, their definition of  $K$  might be directly added to LD without creating the troublesome formula  $(K+A)$ . It helps to avoid all the problems from the second section. In addition, Rabinowicz and Segerberg deal with the two-dimensional system as well and the pair of dimensions they use can be identified with the pair of dimensions used by Kaplan. That's why I conclude that we can have *the Logic for Knowledge and demonstratives* (LD+K) and treat it like a possible extension of LD.

This conclusion equips us with a formal tool to analyze sentences like 'It is known that I am here now' that was unanalyzable in the original formal system. Doing something that we were not able to do in the past is a step towards progress in the philosophy of language. In this way, my thesis contributes to the development of philosophical methodology we have.

However, the thesis creates a room for some future research. I was dealing only with epistemic operator  $K$  and its interpretation as 'It is known that' but there

are several ways to improve my result. For example, we may add an agent who knows something and interpret K as 'It is known for an agent a that'. Another way for future research is an opportunity to introduce some epistemic (and not only epistemic) operators. We may add an operator B 'it is believed that' or try to add some other. Anyway, this thesis makes a contribution to the theoretical philosophy either as some methodological improvement or as a base for some further research.

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## Abstract

The thesis aims to demonstrate how an epistemic operator  $K$  can be added to the Logic of Demonstratives. I started with a description of Kaplan's LD. First off, I showed two reasons motivated Kaplan to create the formal system LD. There are several contingent logical truths in LD but one of them  $\phi \leftrightarrow A\phi$  played a crucial role in my further reasoning. In the second section of the thesis, I tried to add the epistemic operator  $K$  to the LD using its standard definition. As a result, I got a formula  $(K+A)$  that leads to a number of weird results. For example, If it is known that  $\phi \leftrightarrow A\phi$  then every truth is known. I argue that LD is inconsistent with the standard interpretation for  $K$ . However, Rabinowicz and Segerberg(1994) provide the non-standard interpretation of epistemic operator  $K$ . They consider necessity and actuality operators as ones with a fixed perspective and allow  $K$  to have a variable perspective. As a result, their definition of  $K$  might be directly added to LD without creating the troublesome formula  $(K+A)$ . It helps to avoid all the problems from the second section That's why I conclude that we can have *the Logic for Knowledge and demonstratives* (LD+K) and treat it like a possible extension of LD. This conclusion equips us with a formal tool to analyze sentences like 'It is known that I am here now' that was unanalyzable in the original formal system

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