Reconsidering the Second Argument on the Veridicality Thesis, "Semantic Argument"

Abstract

According to the Veridicality Thesis (VT), semantic information must encapsulate truth. Luciano Floridi's Semantic Argument (SA), the argument from semantic loss of information, is a typical argument in favor of VT. SA claims that VT can be derived using the principles assumed in information theory and philosophy of information. However, I shall show that SA cannot derive VT because (1) an essential assumption for SA is made in the wrong way, and (2) even if we assume the premises are correct, it doesn't add up unless we assume the impossible assumption of negativity of information. From the above, I conclude that Floridi's defense of VT has failed.

1 Introduction

The concept of information is generally known to be polymorphous, and among them, information accompanied by meaningful content is especially called "semantic information[1]," which is distinguished from other concepts of information, such as "data" and "natural information." When the nature of semantic information is discussed in the philosophy of information, its truthfulness is often a point at issue. According to the Veridicality Thesis (hereafter, "VT"), which is one pole in the dispute, it is impossible for semantic information to be false in its meaningful content, and it must be true. Floridi is a leading defender of VT and has attempted to defend it in various ways (Floridi 2004b; 2005; 2007; 2011). Among them, the "Semantic Argument" (hereafter, "SA") presented in 2007 is positioned as the second argument and is highly praised by Floridi himself, as he "hope[s it] will be conclusive, in favor of the veridicality thesis" (Floridi 2007, p.32, quoter in parentheses).

Floridi calls the approach that calculates the information content of semantic information based on probabilities the "Theory of Weakly Semantic Information" (hereafter, "TWSI") and distinguishes it from the "Theory of Strongly Semantic Information" (hereafter, "TSSI"), an approach that calculates it based on truth-

1 The way the concept of information is organized differs from theorist to theorist, but among them, Floridi's "a map of information concepts" is the most famous (Floridi 2010). Information accompanied by meaningful content is called both "semantic content" and "semantic information," and Floridi distinguishes between "semantic content" as that which is alethically neutral and "semantic information" that is such that is true. However, there is a persistent position that all information accompanied by meaningful content, regardless of whether it is true or not, should be treated as "semantic information" (e.g., Scarantino and Piccinini 2010).

values and semantic discrepancy with respect to a given situation (Floridi 2004b; 2011, p.108). For example, it can be organized that Bar-Hillel, Carnap, and Dretske adopt TWSI, while Floridi adopts TSSI. Note that, TWSI includes both those who adopt the self-information content ($I = -\log p$) used in information theory and those who adopt the semantic content ($(CONT) = 1 - p$) formulated by the Inverse Relation Principle, which will be explained in section 3. In this paper, we are only concerned with the perspective of how Floridi perceives TWSI, and we adopt Floridi's classification as is (Floridi 2004a; 2004b; 2011, p.31).

SA presented by Floridi is an innovative argument that VT can be derived by argumentation without using TSSI, as long as the "four principles" employed in TWSI and information theory and the "semantic properties of information," which will be discussed later, are assumed.[2] However, contrary to the innovativeness of this claim, few studies have addressed and examined SA in detail when compared to other arguments in defense of VT, including the first argument, "Splitting Test."[3] Even when they are taken up, it is difficult to say that they are being examined satisfactorily.

Therefore, this paper critically reconstitutes the structure of SA and recaptures its significance under the following composition. First, after reviewing the original argumentation by Floridi in section 2, I shall point out in section 3 that the core ideas of SA are the "distinction between domains of discussion" and the "interpretation of informative content H." Section 4 then reconstitutes SA using these ideas as clues and identifies the problems with it. Finally, it is shown in section 5 that VT cannot be derived even assuming that the assumptions used for the argument are correct, and furthermore, that the assumptions are found to be faulty in the first place. It is hoped that the discussion in this paper, in addition to providing a more accurate picture of the structure of the SA itself, will highlight the uniqueness of Floridi's view of semantic information when contrasted with other theorists.

2 How did Floridi attempt to derive VT?

First, we would like to overview the original argumentation by Floridi to see what steps SA is carried out. SA uses the following vocabulary under a two-values logic.

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2 As will be detailed in section 5, the basis for Floridi's belief that the four assumed principles are "standard" and "uncontroversial" is the following three books classified as TWSI: Bar-Hillel and Carnap (1952), Dretske (1981), and Barwise and Seligman (1997), and van der Lubbe (1997), a textbook on information theory, for a total of four books. However, as mentioned above, since TWSI and information theory may differ in their methods of calculating the information content, it is not obvious whether the principles of information theory can be applied as is to the information content employed in TWSI.

3 A similar point is made by Demir (Demir 2014, p.119).

D	:	(possibly empty) domain of propositions ; $\{p_1, \ldots, p_n\}$
φ, ψ	:	propositional variables ranging over D
S	:	(possibly empty) domain of instances of information ; $\{i_1, \ldots, i_n\}$
x, y	:	propositional variables ranging over S[4]
$t(\varphi)$	:	φ is contingently true
$f(\varphi)$	:	φ is contingently false
$t/f(\varphi)$	:	φ is contingently true or false
$T(\varphi)$	:	φ is a tautology
$C(\varphi)$	:	φ is a contradiction
$H(\varphi)$	:	primary informative content of φ
$P(\varphi)$	:	probability of φ [5]

Here, S is a subset of D, since all semantic information is assumed to take the form of propositions. In addition, the following four principles are introduced as "standard assumptions" that are "uncontroversial" in information theory and philosophy of information based on TWSI (Floridi 2007, p.35; 2011, p.99).

P1 : $\forall x H(x) \geq 0$
(principle of the non-negative nature of information)

P2 : $\forall x \forall y((x \neq y) \rightarrow (H(x \cup y) = H(x) + H(y)))$
(additive principle)[6]

P3 : $\forall \varphi((P(\varphi) = 1) \rightarrow (H(\varphi) = 0))$
(inverse relationship principle)[7]

P4 : $\forall \varphi((H(\varphi) = 0) \rightarrow \neg(\varphi \in S)$

According to Floridi, we "should implement" these four principles to obtain "any satisfactory understanding of semantic information" (Floridi 2007, p.34; 2011, p.98).

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4 Although not mentioned in Floridi's original paper, these variables are used in P1 and P2 as variables on S; hence, I added them.

5 Although Floridi's original paper stated "$P(x)$" using variables on S, Floridi himself applied probability to variables on D; therefore, I modified it using variables on D.

6 The imprecision of P2 is dealt with in Section 5. The original additivity is said for "two independent" variables, but Floridi describes it as "two different" variables (Floridi 2007, p.34; 2011, p.98).

7 Although described by Floridi as the "Inverse Relationship Principle (IRP)," P3 is not the IRP itself, but an expression that takes only the case with probability 1 out of the IRP. The reason why IRP itself is not included among the four principles is probably because "informative content H" is not considered as a quantity that is calculated simply according to IRP alone, as will be discussed in section 3.2.

Floridi begins his argument by equating S and D. That is, he assumes that all information takes the form of propositions and that all propositions are information. However, from P3 and P4, we can say the following.

(1)	$T(\varphi) \rightarrow (P(\varphi) = 1)$	(from the probability axiom)
(2)	$(P(\varphi) = 1) \rightarrow \neg(\varphi \in S)$	(from P3 and P4)
(3)	$T(\varphi) \rightarrow \neg(\varphi \in S)$	

Despite the assumption that S and D are the same set, the principles assumed lead to the conclusion that the tautology is not an element of S. This means that the first assumption that S and D are the same set is false. Therefore, it is reasonable to assume that S is a subset of D that does not contain tautologies.

By the way, the current model of S makes the following inference reasonable.

(1)	$(P(\varphi) = 0) \rightarrow (P(\varphi) < 1)$	
(2)	$(P(\varphi) < 1) \rightarrow (\varphi \in S)$	(from the current assumption[8])
(3)	$C(\varphi) \rightarrow (P(\varphi) = 0)$	(from the probability axiom)
(4)	$C(\varphi) \rightarrow (\varphi \in S)$	

In TWSI, which calculates information content based on probabilities, the less likely propositions are, the greater the information content; therefore, the contradiction becomes the most informative proposition. This is what Floridi calls the "Bar-Hillel & Carnap Paradox" (cf. Bar-Hillel and Carnap 1952) and is unavoidable as long as TWSI is employed. How one treats this counterintuitive result that "contradiction is the most informative" depends on the position one adopts, but if one follows Floridi's policy of eliminating contradictions, the model of S should be modified as follows.[9]

$$\forall\varphi\big(\big(T(\varphi) \vee C(\varphi)\big) \rightarrow \neg(\varphi \in S)\big)$$

The current model of S is a set of contingencies. In this model, we can say the following from P1 and P2.

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8 The first explicit assumption is that D and S are the same set, and the hidden assumptions are that all elements in D have probability and that we are now considering only propositions as having probabilities. That is, if something has probability, it is an element of D or S. However, at this step, the set of D minus the tautology is the same set as S. Therefore, having a probability less than 1 means the same thing as being an element of the current S.

9 The way to handle the information content of contradiction and inconsistency varies from one theorist to another, but there are three main policies that can be considered. (1) assigning zero information value, (2) assigning infinite information value, and (3) eliminating all inconsistent cases from consideration. In SA, it reads as if (3) is adopted, but even if (1) is adopted, the contradictions are excluded from S by P4, and the result remains the same.

$$\forall\varphi\forall\psi((\varphi \neq \psi \wedge t/f(\varphi) \wedge t/f(\psi) \rightarrow (0 < H(\varphi) < H(\varphi \cup \psi) > H(\psi) > 0)) * [10]$$

Alternatively, it could be paraphrased as follows[11].

$$H(\cup_1^n \varphi) \leq H(\cup_1^{n+1} \varphi)$$

Since information is nonnegative (P1) and additive (P2), the informative content H in the repository should increase monotonically without decreasing, when contingencies are fed into the information repository one after another.

In the current model of S, the informative content in the repository cannot be reduced unless it is physically damaged. However, Floridi lists the following R1 and R2 as requests that we should "try to satisfy […] if possible" (Floridi 2007, p.34; 2011, p.98).

R1 : Informative contents can decrease syntactically, without necessarily being damaged or erased physically.

R2 : An information repository is unlikely to be increased by adding any contingent proposition.

For example, after "p" is submitted to the repository, consider the operation of submitting "$\neg p$", which is inconsistent with the immediately preceding proposition. Then, "p" and "$\neg p$" have their own informative content, but when the mutually inconsistent two propositions are combined in the repository, "$p \vee \neg p$", that is, a tautology is formed[12]. However, as noted above, tautologies must be eliminated from the elements of S. Hence,

$$\diamond(H(\cup_1^n \varphi) > H(\cup_1^{n+1} \varphi))$$

must be syntactically established[13]. With this, tautologies, contradictions, and inconsistencies have been

10 In section 4 of this paper, I shall adopt Enomoto's interpretation, and consider that the variables are erroneously described using variables on D when they should have been described using variables on S (Enomoto 2020). However, in section 2, we intentionally left the notation as it was in Floridi's original paper, partly because we want to overview Floridi's argument in its original form as much as possible.

11 Floridi describes it this way, but it should be described exactly the way I modified it in Section 4. Note although this expression "$H(\cup_1^n \varphi)$" is used without explanation, it means that by repeatedly applying P3, the informative content is calculated by connecting the 1st through n-th variables submitted to the information repository with disjunction.

12 It is difficult to understand in his explanation the mechanism by which the informative content of the entire repository is reduced when a proposition that is inconsistent with the previous one is put into the repository. It seems that "$p \vee \neg p$" would not be formed in the repository if one only added "p" at one stage in the repository and then added "$\neg p$" at some subsequent stage. This point will be mentioned again in section 4.

13 The operator "$\diamond$" is used here to denote possibility, not in the sense strictly defined by possible worlds and accessibility relation, but simply in the everyday sense of "is possible" or "could be."

eliminated from S.

However, Floridi argues that even in the current model, the phenomenon of what might be called "semantic loss of information" has not yet been realized. For example, we have the intuition that when a true proposition is rewritten (or negated using the operator "¬"[14]) as a false proposition, the semantic informative content of the original true proposition is lost. Therefore, the third requirement R3 must be satisfied.

R3 : Informative content can be lost both physically, syntactically, and semantically.

That is,

$$\Diamond(H(\cup_1^n \varphi) > H(\cup_1^{n+1} \varphi))$$

must be semantically established. This motivates the elimination of false contingencies and leads to the following conclusions.

$$\forall\varphi((\varphi \in S) \rightarrow t(\varphi))$$

The last remaining model of S is a set of true contingencies, which is nothing more than the assertion of the "Veridicality Thesis" that semantic information must be true. This is an overview of SA.

3 Preparations for discussion

In section 2, we reviewed how Floridi attempted to derive the VT. However, as Enomoto points out, the original SA seem to contain some typographical errors and explanatory omissions that do not make sense in this form (Enomoto 2020). Furthermore, the assumption about the domain of discussion for variables is not utilized in the argumentation, and there remains ambiguity as to how to interpret the informative content H. Therefore, as preparations for discussion to reconstitute SA to make sense, Section 3 shall clarify the issues by focusing on the "distinction between domains of discussion" and "interpretation of informative content H."

3.1 On the distinction between domains of discussion

Floridi distinguishes the following domains of discussion for the vocabulary and four principles used in the SA.

P1 and P2 concern S and the cumulative nature of informative contents. P3 and P4 concern D and

14 Floridi lists four things that cause "semantic loss": "falsification," "negation," "making propositions satisfiable by all possible worlds," and "making propositions inconsistent" (Floridi 2007, p. 40). However, since the latter two correspond to the elimination of tautologies, contradictions and inconsistencies described in the preceding step, only the former two are considered in this paper.

the relation between information and probability. (Floridi 2007, p.35; 2011, p.99)

Nevertheless, this distinction is not utilized at all in the actual argument (see section 2). This is the first point that seems puzzling about SA.

As mentioned earlier, D is the set of propositions and S is the set of information. Since any information is assumed here to be in the form of propositions, S is a subset of D. In other words, since the elements of S are also the elements of D, the properties given to D can be applied to the elements of S. For example, since P3 and P4 are described using variables on D, the principle is applicable to the entire domain of **Fig.1**, including S. However, the properties given to S are not applicable to the elements of $D \cap \bar{S}$. For example, since P1 and P2 are described using variables on S, the principle can be applied to the polka-dot portion of **Fig.1** (S), but not to the shaded pattern ($D \cap \bar{S}$).

In summary, all principles from P1 to P4 can be applied to the polka-dot patterned area in **Fig.1**, that is, the domain of discussion of S. In contrast, only two principles, P3 and P4, can be applied to the shaded area in **Fig.1**, that is, the domain of discussion of D, excluding S ($D \cap \bar{S}$). This distinction between domains of discussion is critically important in the reconstruction of SA to be done in section 4, but this point has been overlooked in previous studies.

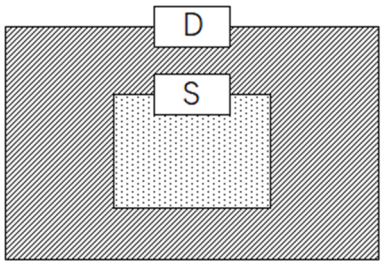

Fig.1 the distinction between domains of discussion

3.2 On the interpretation of the informative content H

The second point that seems puzzling about SA is that it does not specify on what calculation the "informative content H" is based. In TWSI, the definition of information content is fundamentally based on the idea of Inverse Relationship Principle (hereafter, "IRP"). As noted in section 1, TWSI includes both those who adopt the self-information content ($I = -\log p$) used in information theory and those who adopt the semantic content ($(CONT) = 1 - p$). Although their calculation methods are slightly different, the mechanism is the same: the lower the probability, the greater the information content, and conversely, the higher the probability, the smaller the information content[15]. This is IRP, and as long as SA is considered

15 The definition of information content such that additivity is satisfied is uniquely determined by the self-

within the framework of TWSI, IRP is likely to be relevant to informative content H.

Furthermore, Floridi himself makes statements in several places that allow the informative content H to follow probabilities. For example, P3 is not itself an IRP, as noted in Note 7, but only extracts the case of probability 1 from the IRP, but the step of eliminating contradictions can be read as directly explaining the use of IRP.

> Since contradictions are most unlikely, to the point of having zero probability, they are very informative. […] Counterintuitively, you may be receiving an increasing amount of information about the outcome of an event by receiving an increasingly unlikely message but, strictly speaking, the most unlikely message is a contradictory one. (Floridi 2007, p.36; 2011, p.100)

From here, we can also expect that IRP is related to informative content H.

On the other hand, it is also suggested that when R3 is introduced, the informative content H does not simply follow probability alone, but is given semantic properties.

> However, according to [9][16], no loss of informative content would occur […]. Quantitatively, this may be true, but semantically it seems unacceptable. (Floridi 2007, p.39; 2011, p.103)

This statement is suggestive because he says that no loss of "informative content" would occur, even though it is possible to have quantitative loss of information. That is, informative content cannot be described only quantitatively.

However, this statement alone does not establish which of the following two meanings of "informative

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information content using logarithms. Perhaps that is why Demir and Lundgren, in questioning the validity of P2, implicitly assume that the informative content H in SA is "self-information content" in the sense of information theory, and then criticize Floridi to the effect that he is misinterpreting P2 (Demir 2014, pp. 128-129; Lundgren 2019, pp. 2894-2895). On the other hand, Demir also describes it as follows.

> It is perhaps worthwhile to state that I could have formulated my criticism by using the inverse relationship between the probability of a proposition and its informative content. I shunned away from doing that, because Floridi's alethic theory of semantic information is based on the criticism of a seemingly paradoxical implication of the probability-based theories of information. […] Therefore, it would have been unfair if I had formulated my criticism in terms of the inverse relationship between probabilities and informative content. (Demir 2014, p.133)

However, it still appears that Demir is criticizing with an interpretation based solely on mere "quantity," which Floridi avoids. Note that since SA is an assertion that VT can be derived from TWSI and information theory plus more, it may be considered separately from the idea of informative content in TSSI (Floridi's alethic theory of semantic information), which is Demir's concern. Note that, technically speaking, the semantic content can also be converted to self-information content if the appropriate procedure is followed (Bar-Hillel and Carnap 1952).

[16] "[9]" refers to a set S whose elements have only contingencies that are not mutually inconsistent with each other, such that R1 and R2 are satisfied but R3 is not. Floridi says that at this stage, it is possible to have only physical or syntactic loss of information, and it is not possible to have semantic loss if information.

content" Floridi employs.

(1) Although it is also possible to view it semantically when viewed from a different perspective, it is essentially a quantitative "informative content" that is consistently calculated based on probability alone.

(2) It is a hybrid "informative content" that has not only simple quantitative properties determined solely by probability, but also semantic properties that are at the same time influenced by factors other than probability.

If we adopt the interpretation in (1), it would be closer to the meaning of "information content" as employed in TWSI and information theory and would seem to fit well with the four principles that are "standard assumptions." In fact, the criticism of P2 by Demir and Lundgren may be based on the interpretation of (1). In this case, however, although the same term "informative content" is used in two different senses in the steps of eliminating inconsistencies and eliminating false contingencies, the very same principle is being applied to the argument. In addition, the sudden switch in usage of the vocabulary term "informative content H" in the middle of an argument is unnatural.

Therefore, I shall consider that one consistent meaning should be assigned to one vocabulary in the SA argument, and we adopt interpretation (2) in this paper. Under this interpretation, the informative content that a true contingency would have had is lost by being rewritten (or negated using the operator "¬") into a false contingency, as well as being calculated roughly according to probability. For example, for propositions with the same probability, the informative content will be greater in the true case than in the false case. Further, if the probabilities are very different, the informative content could be greater in the false case than in the true case.

In adopting the interpretation of (2), the idea of "epistemic-value" by Scarantino & Piccinini is useful for understanding (Scarantino and Piccinini 2010).[17] According to this idea, when probabilities are the same, false contingencies are epistemologically inferior to true contingencies and have lower informative content. In other words, it is the epistemic-value of information that is the informative content H in SA, which basically changes in quantity according to the information-probability relation as described in the IRP, but which is not determined simply by probability alone and is greater when it is true. This seems to be consistent with the use of the unfamiliar notation "informative content" instead of the more common "information content" for self-information content, and with the fact that IRP itself is not adopted as one of the four

17 Scarantino & Piccinini consider three cases of Floridi's information loss phenomenon: quantitative, qualitative, and epistemic-value loss. The quantitative loss of information is the loss that occurs when the relevant information instance is removed from the information repository if the interpretation in (1) is adopted. Also, there is a qualitative loss of information in the sense that, for example, when one propositional content is rewritten into another, it is no longer the same propositional content.

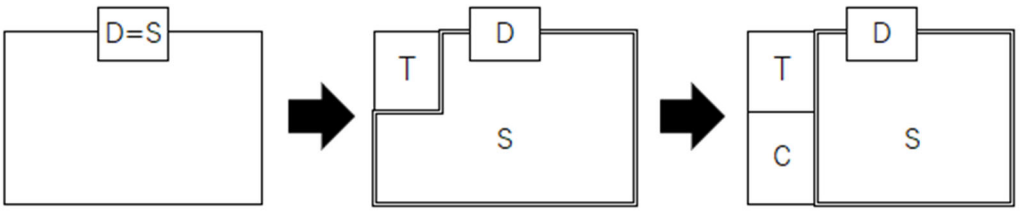

Fig.2 information model S_1 eliminating tautologies and contradictions from D

principles.[18]

4 Reconstituting SA

Reconstituting SA can be done by considering the two ideas organized in section 3 as the nucleus of SA. Although there are still some problems in the reconstructed arguments below, as will be discussed in section 5, this section aims to restore the arguments that Floridi would have originally wanted to make and to compensate for his typographical errors and omissions in the explanations. First, there is no problem until the step of eliminating tautologies and contradictions. In other words, the information model S_1 at this point is as shown in **Fig.2**. At this point, in the domain of discussion of S, the following holds.

$$\forall x \forall y((x \neq y) \rightarrow (0 < H(x) < H(x \cup y) > H(y) > 0)) * [19]$$

Alternatively, it could be paraphrased as follows (Note that this is different from the notation in Section 2).

$$\forall x \forall y((x \neq y) \rightarrow (H(\cup_1^n x_i) \leq H(\cup_1^{n+1} x_i)))$$

where the index "i" is integer greater than or equal to 1. Floridi's original argument uses the variables "φ" and "ψ" on D. As Enomoto points out, this is a misprint for the variables "x" and "y" on S (Enomoto 2020, p.51). As discussed in section 3, P1 and P2 are assumed to be principles that can only be applied to S. Therefore, a monotonic increase in informative content will occur in S_1.

Here, Suppose the operation of submitting "p" to the n-th and "$\neg p$" to the n+1-th of the information repository. In this case, as noted in Note 12, the tautology "$p \vee \neg p$" is not immediately generated as Floridi states, so we must interpret it as follows. From P2, if "x" and "y" are different variables on S, then $H(x \cup y) = H(x) + H(y)$. Since the two variables "p" and "$\neg p$" currently considered are on S and different

18 If the IRP is adopted as is as a principle, the informative content H would be determined only by probability; therefore, it can be interpreted that the principle dares to take out and adopt only the case with probability 1.

19 When we reviewed Floridi's argument in section 2, the expression was used to specify that the two variables are contingencies. However, by rewriting it using variables on S, "x" and "y" cannot be tautologies or contradictions at this point. Therefore, the expression specifying that "x" and "y" are contingencies is redundant.

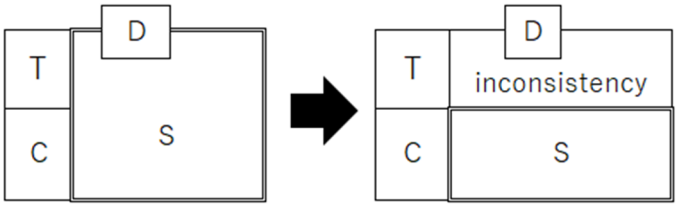

Fig.3 information model S_2 eliminating inconsistencies from S_1

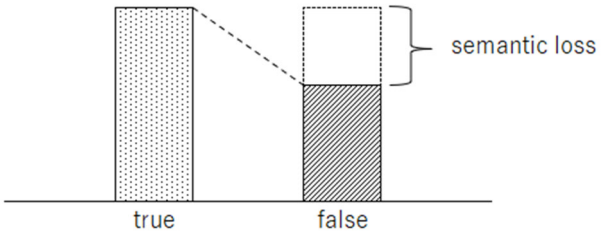

Fig.4 semantic loss of information

ones, the total informative content of $H(p)$ and $H(\neg p)$, computed independently of each other, should be equal to $H(p \cup \neg p)$. However, since "$p \vee \neg p$" is a tautology, $H(p \cup \neg p)$ will be zero, and not only the informative content of the n+1-th input "$\neg p$", but even the informative content of the n-th input "p" will be lost. The result would be that the total informative content up to the n+1-th would be less than the total informative content up to the n-th, just as Floridi said! In other words, there is a case in S_1 in which the following is true (abbreviated for simplicity).

$$H(\cup_1^n x_i) > H(\cup_1^{n+1} x_i)$$

However, this contradicts the principle of monotonic increase in S_1. This is because "$H(\cup_1^n x_i) > H(\cup_1^{n+1} x_i)$" cannot be simultaneously true in S_1, where the principle is "$H(\cup_1^n x_i) \leq H(\cup_1^{n+1} x_i)$". The fact that a contradiction arises means that the assumption that S is identical to S_1 was incorrect. Thus, an information model S_2 is obtained that eliminates the inconsistencies that cause such discrepancies in S_1 (**Fig.3**).

In the current model S_2, the informative content continues to monotonically increase from P1 and P2 ($H(\cup_1^n x_i) \leq H(\cup_1^{n+1} x_i)$ holds). The informative content in SA is more informative (epistemologically valuable) when it is true than when it is false. In this case, if we take the operation of rewriting a true contingency into a false contingency (or negating it using the operator "¬"), we will have a semantic loss as shown in **Fig.4**. In other words, the following holds in S_2.

$$H(\cup_1^n x_i) > H(\cup_1^{n+1} x_i)$$

However, this contradicts the principle of monotonic increase in S_2. This is because "$H(\cup_1^n x_i) >$

$H(\cup_1^{n+1} x_i)$" cannot be simultaneously true in S_2, where the principle is "$H(\cup_1^n x_i) \leq H(\cup_1^{n+1} x_i)$". The fact that a contradiction arises means that the assumption that S is identical to S_2 was incorrect. Thus, an information model S_3 is obtained that eliminates the false contingencies that are the cause of such inconsistency in S_2 (**Fig.5**). The information model S_3 thus obtained is the set of true contingencies ($t(\varphi)$), which is nothing but VT.

Reconstituting SA with the compensation of Floridi's misprints and omission of explanations, we can see above that the distinction between the domains of discussion and the interpretation of informative content H is important in SA.[20] This argument would not be possible without relying on the fact that the domains of discussion of P1 and P2 is restricted to S alone and cannot be applied to any other domain (D ∩ $\bar{S}$). Moreover, semantic loss can only be explained by a conception of informative content with epistemic-value, based on Floridi's own interpretation, rather than a mere quantitative interpretation as understood in previous studies.

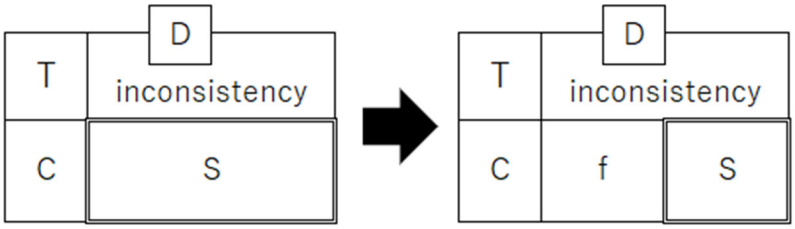

Fig.5 information model S_3 eliminating false contingencies (f) from S_2

5 Why can't we derive VT via SA?

In section 4, I have reconstituted SA as Floridi would have originally wished to do, by making up for typographical errors and explanatory omissions in the original argument, and by considering the two ideas of " distinction between domains of discussion" and "interpretation of informative content H" as the nucleus of SA. However, because of the flaws in the reconstituting SA as described above, it is not possible to derive the VT. In this section, I shall show this separately for the case where the four principles are assumed to be correct and for the case where the four principles are assumed to be faulty.

5.1 Assuming the four principles are correct

First, I shall proceed by assuming that the four principles on which the argument is premised are "standard" and "uncontroversial," as Floridi states.

In this paper, I take the same position as Demir in that there is no problem up to the elimination of inconsistencies (Demir 2014). In subsequent steps, however, Demir considers the informative content H in

20 Note that Lundgren interprets P4 as the core of SA (Lundgren 2019).

SA as a simple quantity and criticizes it as follows. In this respect, this paper and Demir differ in their positions.

> However, it is absurd to expect a loss of information in this case [(when negating a proposition)], because both R and not-R are assumed to have the same amount of informative content. […] Do we expect a loss of information in the repository if "the outcome of flipping a coin at time t_1 is heads" was just replaced with "the outcome of flipping a coin at time t_1 is tails"? The answer seems to be clear NO, because both the original statement and its negation have the same amount of informative content. (Demir 2014, p.131, quoter in parentheses)

However, as I stated in section 3, Floridi can be interpreted as giving the informative content H the property that it has a greater amount when true. Thus, when R is true, its negation, ¬R, has a smaller informative content than that of R, even if the probability of occurrence is the same for R and ¬R. In other words, there would be a loss of information. Thanks to this interpretation of informative content H, Floridi can escape Demir's criticism.

Here, I consider again what kind of operation Floridi is performing in the last step. Floridi describes semantic loss as follows.

> Suppose this [(statement)] is true. This informative content could be lost […] but also if some false statement is added or if the meaning is changed. (Floridi 2007, p.39; 2011, p.103, quoter in parentheses)

According to this explanation, we are not feeding new propositions into the repository, but rather we are operating by adding false statements to a certain true proposition and rewriting it into a false proposition, or rewriting the original proposition so that its meaning changes.

Now, the current information model is S_2, which eliminates up to inconsistencies. In this model, if the k-th true proposition is t_k and the proposition that rewrites it false (or negates it using the operator "¬") is f_k, then using P1 and the interpretation of informative content H, we can say

$$0 \leq H(f_k) < H(t_k)$$

Note that since S_2 is a candidate for S now and a set of all contingencies regardless of their truth-value, P1 can of course be applied to false propositions.

Looking back at what Floridi has done in the previous steps, when eliminating inconsistencies, the input of the n+1-th proposition reduces the total informative content to less than the total up to the n-th. However, what Floridi is doing in the last step is rewriting the n+1-st true proposition to false one (or negating it using the operator "¬"), and we are looking at the change in informative content between the n+1-th proposition and n+1-th one (**Fig.6**).

Indeed, if we compare the n+1-th to the n+1-th, the truer t_{n+1} is, the smaller the informative content of f_{n+1}, which is rewritten to false (or negating it using the operator "¬"), and a loss of information is

admitted ($H(f_{n+1}) < H(t_{n+1})$). However, when compared to the informative content $H(\cup_1^n x_i)$ up to the n-th, the informative content $H(\cup_1^{n+1} x_i)$ up to the n+1-th is still larger (when $H(f_{n+1}) > 0$), or at least the same amount (when $H(f_{n+1}) = 0$), as **Fig.6** shows. In other words, a semantic loss between n+1-th and n+1-th does not imply a semantic loss from n-th.

The above facts mean that false contingencies cannot be eliminated uniformly. If one wants to eliminate false contingencies uniformly, then when the n+1-th false contingency is submitted to the repository, the loss of information as shown in **Fig.7** (on the next page) must be allowed. However, for such a loss of information to occur due to the single input of a false contingency, the false contingency must have some negative informative content. In other words, we must assume the existence of a false contingency such that $H(\varphi) < 0$ in the domain of discussion of D. However, neither TWSI nor information theory (and even TSSI) gives negative informative content, and this is inconsistent with the interpretation of informative content H. Even if we were to allow only false contingencies to be given negative informative content, Floridi's intuition that "false contingencies are not semantic information, but only true contingencies are semantic information" would have entered the principle P1 in advance, which is a preemptive argument.[21]

From the above, SA can only lead up to the elimination of inconsistencies, and what is accepted as "information" by this model is a set of mutually consistent, alethically-neutral contingencies.

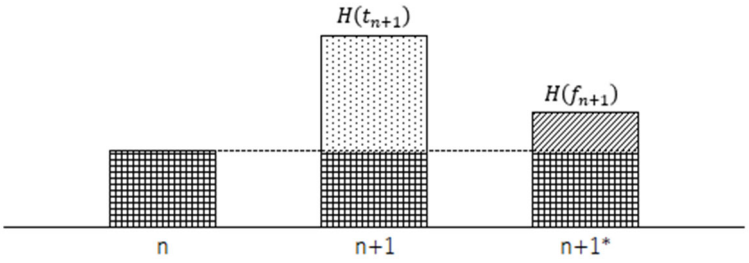

Fig.6 comparison of informative content between n+1-th and n+1-th

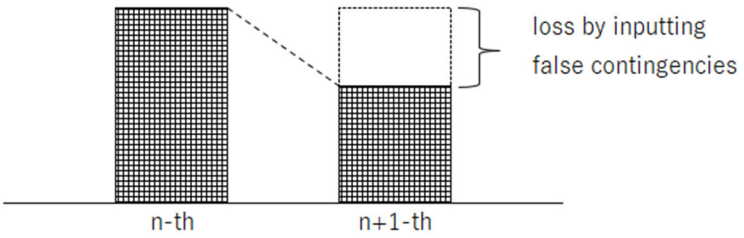

Fig.7 when the informative content of the false contingency is negative

21 Although I say " Even if we were to allow only false contingencies to be given negative informative content," it seems difficult to imagine what it would mean for an informative content to have a negative quantity. If the total informative content is reduced by putting a false contingency into the repository, then false contingencies, in general, have the power to erode the informative content of other contingencies. This idea seems absurd.

5.2 Assuming the four principles are in error

Again, according to Floridi, the four principles to be implemented are "standard" and "uncontroversial" in information theory and philosophy of information (TWSI). Specifically, Floridi states that he is using the assumptions employed in Bar-Hillel and Carnap (1952), Dretske (1981), Barwise and Seligman (1997), and van der Lubbe (1997) (Floridi 2007, p.35; 2011, p.99).

However, multiple criticisms have already been made against these principles themselves. For example, Demir and Lundgren point out that Floridi's P2 is based on a false interpretation.

> The reasoning here is based on a specification of the additive principle that is incomplete. In other words, P2 is not the correct formulation of the additive principle. […] This formulation […] clearly implies that additive principle does not apply to mutually inconsistent propositions, because mutually inconsistent propositions are not independent of each other. (Demir 2014, pp.128-129)

> There are three problems. First, it is not clear how we should interpret “different instances of information”; clearly, it does not follow from the formalism. Second, if we have two different instances of information with a great overlap then their informative content is obviously not equal to the sum of their individual informative content. […] Third, the principles are, in fact, incompatible even with GDI[22] (Lundgren 2019, pp.2894-2895, footnote 15)

Moreover, Lundgren addresses and criticizes P4, namely the principle that anything lacking informative content is not information. In addition, even if the literature mentioned above (Bar-Hillel and Carnap 1952; Dretske 1981; Barwise and Seligman 1997; van der Lubbe 1997) supports Floridi's claim, it has been criticized as merely *argument ad populum* (Lundgren 2019, pp.2894-2895).

All the above criticisms seem reasonable. However, it is probably possible for Floridi to avoid the above criticisms by interpreting his claim favorably as follows: Since Floridi assigns unique property to the informative content H as we saw in section 3, such unique additivity can be established for the informative content H based on such a unique interpretation![23]

What this paper is concerned with, then, is not the validity of each principle itself, but rather the way in which the domains of discussion identified in section 3 is set up. Even if the formulas of these principles set up by Floridi are found to be legitimate and exempt from all the above criticisms, the way in which the domains of discussion are set up is “non-standard” and is highly “controversial.”

For example, according to P1, non-negativity of information is only valid in S. In other words, it is

22 GDI is semantic information in the sense Floridi claims, defined as "well-informed, meaningful, and veridical data."

23 But then the four principles would no longer be "standard" or "uncontroversial" at all.

suggested that non-negativity may not hold in $D \cap \bar{S}$, which raises the problem of propositions with negative informative content, as pointed out in 5-1. Indeed, if P1 holds only in S, then it is reasonable that the domain of discussion of P2 is also limited to S. This is because if the informative content of a proposition can be negative in $D \cap \bar{S}$, then the domain of discussion of P2 must be limited to S, since additivity cannot hold to the extent that P1 does not apply.

However, in practice, the informative content of a proposition can never be negative; hence, P1 is a principle on D, and accordingly, P2 is also a principle on D. Hence, the four principles should be modified using variables on D as follows.

P1' : $\forall\varphi H(\varphi) \geq 0$

P2' : $\forall\varphi\forall\psi((\varphi \neq \psi) \rightarrow (H(\varphi \cup \psi) = H(\varphi) + H(\psi))$

P3' : $\forall\varphi((P(\varphi) = 1) \rightarrow (H(\varphi) = 0))$

P4' : $\forall\varphi((H(\varphi) = 0) \rightarrow \neg(\varphi \in S)$

The domain of discussion for all four principles is D. The latter part of SA, that is, the part after the step of eliminating inconsistencies, relies on the setting of the domains of discussion. Therefore, if the setting of the domains of discussion becomes invalid, then although it is a valid argument up to the step where the tautologies and contradictions are eliminated, all subsequent arguments are no longer valid.

Note, however, that since mutually inconsistent propositions generate "$p \vee \neg p$" (tautology) or "$p \wedge \neg p$" (contradiction) in the repository, it would not be a serious problem if they are excluded from S regardless of the setting of the domains of discussion, as Demir also points out (Demir 2014, p.129). In other words, even in this case, SA can only lead up to the elimination of inconsistencies, and what is accepted as "information" by this model is a set of mutually consistent, alethically-neutral contingencies.

6 Conclusion

Finally, let us review again the flow of this paper's argument and the significance derived from it. Although Floridi presented an argument in defense of VT, called SA, his original argumentation seemed to contain some typographical errors and explanatory omissions, and at first glance it appeared that there was a leap in logic. Therefore, in the first half of this paper (sections 2–4), I pointed out that the core idea of SA does not lie in the points that have been mentioned in previous studies, but in following two points; the distinction between domains of discussion and the interpretation of informative content H. With that in mind, I reconstituted the revised SA using these points as cues. This process of reconstruction revealed some problems in SA that were difficult to detect in the original argumentation in the latter half of this paper (section 5). Specifically, it was found that the VT could not be derived without assuming the negativity of information, and furthermore, it contained errors at the stage of setting the domains of discussion. These

problems are suggestive of how Floridi views semantic information. Thus, because of the problems with process and premises, VT could not be derived, and only the set of contingencies (information model S_2), which excludes tautologies, contradictions, and inconsistencies from D, was left at hand.

However, the failure to derive VT does not mean that the current information model S_2 is inconsequential. For example, Bar-Hillel & Carnap Paradox is said about contradictions, but the current information model S_2 avoids this paradox because it already eliminates contradictions and inconsistencies. Moreover, by interpreting the informative content H in the manner organized in section 3, differences arise in epistemic-value between true and false contingencies, and an epistemic advantage can be granted to the true contingencies. In this respect, even the current information model S_2 can yield fruitful results.[24]

Note, however, that what I want to show in this paper is only that SA cannot derive VT, and I do not intend to state anything more than that (e.g., "It is impossible to derive VT in principle" or "there is no significance in supporting VT"). This raises the question of whether it is possible to derive VT by other means, and whether the disadvantages of refusing VT are negligible, as future issues that could not be dealt with in this paper.

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24 The point that even alethically-neutral information models can (or do) build fruitful theories has been made by numerous commentators, especially in the empirical sciences (e.g., Dodig-Crnkovic 2005; Scarantino and Piccinini 2010).

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