May 18th, 9:00 AM - May 21st, 5:00 PM

Commentary on “On Appeals to (Visual) Models”: Appeals to Visual Models – An Epistemological Reconstruction of an Argument Type

Christoph Lumer
University of Siena

Commentary on “On Appeals to (Visual) Models”: Appeals to Visual Models—An Epistemological Reconstruction of an Argument Type

CHRISTOPH LUMER
DISPOC
University of Siena
Via Roma 56
53100 Siena
Italy
lumer@unisi.it

1. Introduction: Dove’s argument scheme ‘appeal to visual model’ and the aim of this paper

Ian Dove (in his paper “On Appeals to (Visual) Models”) has developed a nice, concise and very helpful theory of an argument scheme called “Appeal to Visual Model”. It captures how we can (and sometimes do) reason from an observation on a visual model to a thesis about corresponding features in reality. The theory is deliberately (Dove, 2016, p. 1) developed in the style of Walton’s “argumentation schemes” (e.g. Walton, Reed, & Macagno, 2008; Walton, 1996) and provides, like Walton, a somewhat formal but altogether rather contentual argument scheme together with critical questions regarding critical points of the argument.

Dove’s (2016) theory is a clear progress because such an analysis of arguments on the basis of visual models so long did not exist, because his analysis makes explicit inferential relations which in the usual talk on visual arguments are not analyzed (p. 8) and thus brings us nearer to an understanding of the rationality behind this reasoning, and because he underpins his analysis with some theory on modelling in general. In particular I appreciate Dove’s effort and endeavour to make explicit as far as possible what goes on in this kind of reasoning for being able to assess it analytically (p. 6). On the other hand, I am critical with respect to Walton’s argumentation schemes approach (see Lumer, 2016). Walton has introduced this approach to resolve the problem of uncertain, i.e., non-deductive arguments (Walton et al., 2008). Some of my main worries with this approach are: It does not provide any underlying theory, no epistemological basis of the schemes, so that it remains unclear why we should believe in the conclusion after having accepted the premisses and having received satisfying answers to our critical questions. Existing inferential relations are not revealed or made explicit. There are no clear criteria for assessing individual arguments with the help of the schemes. There is a confusingly long list of not systematized contentual schemes, which should be reduced to underlying formal argument types. The critical questions sometimes may focus our attention to particularly critical points of the argument, but often they only question the truth of some premise, and they do not help at all to resolve the problem of argumentative validity. The conclusion does not contain any qualifier which captures its degree of uncertainty. Etc.

I think these problems can be resolved only by an espistemological approach to argumentation. Furthermore, Dove’s analysis of appeals to visual models already have brought us rather near to an epistemological analysis of this type of argument. Therefore, in what follows I will procede this way. First, I will expose an analysis of appeals to visual models on the basis of the epistemological approach to argumentation, thereby using Dove’s very instructive examples.

Bondy, P., & Benacquista, L. (Eds.). *Argumentation, Objectivity, and Bias: Proceedings of the 11th International Conference of the Ontario Society for the Study of Argumentation (OSSA), 18-21 May 2016*. Windsor, ON: OSSA, pp. 1-10.

Subsequently I will compare Dove's Waltonian theory of the appeal to visual models with this epistemological analysis and in doing so assess the relative advantages of both approaches.

2. An epistemological analysis of appeals to visual models

Dove provides two extensive examples of appeals to visual models. The first is a reasoning about the quickest route from the present position to a nearby pub. There are three proposals of routes which on the one hand differ in length but on the other may be quicker in spite of exceeding length because of avoiding time-consuming obstacles, namely crossing slow intersections, since the route passes less intersections or / and some intersections are provided with pedestrian bridges. As the situation is somewhat confusing the persons involved consult a map from which the distances can be read, the intersections can be counted and the footbridges individuated. With the help of this information the quickest route is determined. The second example regards an x-ray on which the doctor individuates a bright line in the representation of a bone and infers from this that the respective bone has a hairline fracture.

The map and the x-ray respectively are, of course, the models which represent aspects of some part of the original: the town and the bone. And the features read from the model or, more precisely, observed in the model and then possibly formulated as 'this route (on the map) is about 10 cm long' or 'here is a bright line within the representation of the bone' etc. are used to infer on corresponding features of the original reality, i.e. the length of the real route and the fracture respectively. This inference is made possible because of the isomorphy between the original and the model. What is an isomorphy? An isomorphy is a relation which holds between two structures, A and B, each of which consist of a set of objects, $a°$ and $b°$, and a set of relations, $F°$ and $G°$, holding between them. Such structures A and B are isomorphic if two conditions are fulfilled: *1. Bijective mapping:* There is a bijective (or one-to-one) mapping Φ between the objects of A and the objects of B as well as between the relations holding in A and the relations holding in B; i.e., to every object a_i of A exactly one object b_i of B is assigned, and vice versa; and to every relation F_i in A exactly one relation G_i in B is assigned, and vice versa. *2. Homomorphism:* If a relation F_i between the objects $a_1, \ldots, a_n$ ($F_i(a_1, \ldots, a_n)$) holds in A the corresponding relation G_i between the corresponding objects $b_1, \ldots, b_n$ in B holds as well, and vice versa.

(A somewhat more formal definition of 'isomorphy' is this:

Formal definition of 'isomorphic':
Two structures A ($A = (a°; F°)$) and B ($B = (b°; G°)$), consisting of the sets $a°$ and $b°$ of objects ($a° = \{a_1, a_2, ..., a_n\}$; $b°$ ($= \{b_1, b_2, ..., b_n\}$) and appertaining sets $F°$ and $G°$ of relations ($F° = \{F_1, F_2, ..., F_m\}$; $G° = \{G_1, G_2, ..., G_m\}$ holding with respect to these objects, are *isomorphic* iff:
There is image function Φ between A und B, for which holds:
1. Φ ist bijective, i.e.: 1.1. Φ is a one-one mapping between the sets of objcetcs $a°$ and $b°$ of A and B [which thus assigns to each a_i from $a°$ exactly one element b_j of $b°$ and vice versa (so for all a_i and b_j holds: $\Phi(a_i)=b_j$ and $\Phi(b_j)=a_i$)]; and 1.2. Φ is a one-one mapping between the sets $F°$ und $G°$ of functions of A und B [which thus assigns to every relation F_i one-to-one a relation G_j (with the same number of places (i.e. for all F_i and G_j holds: $\Phi(F_i)=G_j$ and $\Phi(G_j)=F_i$)]. And

2. Φ ist homomorph, i.e.: $\forall a_1, ..., a_n \forall F_i$: $(F_i(a_1, ..., a_n)) \leftrightarrow \Phi(F_i)(\Phi(a_1), ..., \Phi(a_n))$ [i.e. if a relation F_i holds between some objects $a_1, \ldots, a_n$ of A the corresponding relation of B (i.e. G_i) must hold between the corresponding objects of $a_1, \ldots, a_n$ (i.e $b_1, \ldots, b_n$), and vice versa].)

If we regard e.g., city maps, the original structure A is the city and the map is the model B. If the map is of the North-American style the bijective relation, with respect to *objects*, regards, among others, in reality: streets, geodetic positions, measures of angles as well as measures of distances and on the the map: black lines, positions on the map (expressible in coordinates) again measures of angles as well as measures of distances (cf. table 1). The bijective relation between these two sets of objects is defined: for the streets, via writing street names next to the respective lines on the map; for the geodetic position by orienting the map such that north is up, sometimes by a grid of latitudinal and longitudinal lines but for city-maps mostly only by writing the city's name on the map; for the measures of angles the assignment is not made explicit but it is the identity relation, so that to an angle of 40° in reality also 40° on the map are assigned; and for the measures of distances the assignment is made via the scale written somewhere on the map, such that for a 1:10,000 scale e.g., to 1 km in reality are assigned 10 cm on the map. (More differentiated maps represent much more types of objects: kinds of streets, buildings, parks, forests, meadows, railway lines etc.; and the bijective attribution, with respect to the type of objects, is defined in the explanation of symbols, e.g., national roads are represented by yellow lines with black borders.) The bijective assignment of *relations* for city maps regards, primarily, geodetic position of objects in reality and position of symbols in the coordinate system of the map and, secondarily, among others lengths of objects as well as angles of boundaries of objects in reality and extensions of symbols as well as angles of intersecting or touching lines on the map. Because these assignments of relations are intuitive, usually they are not made explicit. *Homomorphism* then is reached by designing a precise map such that all objects of the kind of objects which the map promises to represent are represented on the map by the respective symbols and that these symbols are at the "right" place on the map.

The isomorphic relation of models to reality should be clearly defined, which implies that the bijective mapping is restricted to clearly defined sets of objects and relations. This means, negatively, that if the model is not a (exact) copy certain kinds of objects and many relations are not represented in the model. It is characteristic of models that the isomorphy between the reality and the model is intentionally and (hopefully) precisely created, either in single steps, manually so to speak—as it is the case of maps or schemata of other things like parental relations, genealogical trees of species, curves of population growth—or mechanically by respective devices—as e.g., with photographs, x-rays, electrocardiograms, automatically created temperature or humidity curves. This implies that models, as far as they are precise and as far as the isomorphy (the bijective relation) goes, can serve as a more or less certain basis for inferences on the represented reality. Within the respective argument—at least in its ideal completely explicit form—then a proposition on the general isomorphy relation between the respective part of reality and the model will be the major premise. And the truth of this premise is guaranteed by the creator of the model, on whose sincerity and preciseness the arguer relies. Since ismorphism is a strong relation this premise, together with premisses on the bijective relations and on observations regarding specific features of the model, allows deductive inferences to strong conclusions about reality.

Table 1: Isomorphy of a city and a city map:

Reality: city	*Model: city map*	*(Way of) bijective assignment*
1.1. Objects		
streets	black lines	street names on the map
geodetic position	position on the map, coordinates	north up, grid of latitudinal and longitudinal lines, city name on the map
measures of angles	measures of angles	identity relation (implicit)
distances	distances	scale written on the map
1.2. Relations		
geodetic position of objects (‘*x* is at position *y*’)	positions of symbols on the map (‘*x* is at position *y*’)	intuitive, not made explicit
lenght of an object (‘*x* is *y* meters long’)	length of objects on the map (‘*x* is *y* cm long’)	intuitive, not made explicit
angles of boundaries of objects (‘the touching boundaries of object *x* and of object *y* stand with the angle *z* to each other’)	angles of intersecting or touching lines (‘line *x* and line *y* stand with the angle *z* to each other’)	intuitive, not made explicit
2. Homomorphism		
Baker St is 1 km long.	The black line with the name “Baker St” aside is 10 cm long.	
Baker St and Cesar St intersect with a right angle.	The black line with the name “Baker St” aside and the black line with the name “Cesar St” aside intersect with a right angle.	

Let us make this idea more precise. What premisses do we need for an ideal, i.e., fully explicit and argumentatively valid, appeal to (visual) models? First, we need as the major premise a proposition on the isomorphic relation between the model and reality, then the premise reporting the observation on the model. For making the inference to the corresponding feature of reality deductively valid we next need premisses saying that the observed feature is part of the model structure—and not e.g., a stain or advertising on the map—and premisses about the bijective correspondences between the observed objects of the model and the represented objects as well as between the observed kind of relation and the represented relation. Finally, for being able to deductively exploit the isomorphy premise we need the isomorphy definition as kind of (analytically true) connecting premise. Together, this is sufficient to then infer to the conclusion about the feature of reality represented by what has been observed on the model. Alltogether we thus get the following argument scheme:

Argument scheme ‘appeal to a (visual) model’:
Pi0: Isomorphy Definition: See above.

Pi1: Representation Relation / Isomorphy: Structure B (with the set $b°$ of objects and the set $G°$ of relations) is a model of the real structure A (with the set $a°$ of objects and the set $F°$ of relations) such that between B and A the isomorphy relation Φ holds.
Pi2: Model Affiliation: The objects $b_1, \ldots, b_n$ are elements of the set of objects ($b°$) of the model (B); the relation G is element of the set of representing relations $G°$ of the model (B).
Pi3: Observation on the Model: Between the objects $b_1, \ldots, b_n$ the relation G holds.
Pi4: Object Correspondences: The counterpart of b_1 (defined by the isomorphy function Φ) in reality A is a_1; …; the counterpart of b_n (defined by the isomorphy function Φ) in reality is a_n.
Pi5: Relation Correspondence: The counterpart of the relation G (defined by the isomorphy function Φ) in reality is the relation F.
Ci: Conclusion: Reality Statement: Between the real objects $a_1, \ldots, a_n$ the relation F holds.

(A somewhat more formal scheme is:

Formal argument scheme ‘appeal to a (visual) model’:
Pf0: Isomorphy Definition: See above.
Pf1: Representation Relation / Isomorphy: The structure B ($b°$; $G°$) is a correct model of the real structure A ($a°$; $F°$), such that between B and A the isomorphy relation Φ holds.
Pf2: Model Affiliation: $b_1, \ldots, b_n \in b°$; $G \in G°$.
Pf3: Observation on the Model: $G(b_1, \ldots, b_n)$.
Pf4: Object Correspondences: $\Phi(b_1) = a_1$; …; $\Phi(b_n) = a_n$.
Pf5: Relation Correspondence: $\Phi(G) = F$.
Cf: Conclusion: Reality Statement: $F(a_1, \ldots, a_n)$.)

Taking up Dove’s first extended example, an ideal, fully explicit appeal to a visual model would be this:

Example of an ideal appeal to visual model:
Pe0: Isomorphy Definition: See above.
Pe1: Representation Relation / Isomorphy: Map B is a model of the street structure of city A in the sense that between B and A holds the isomorphy relation Φ (in the North-American style of city maps: streets are represented by black lines, …; the scale is 1:10,000 …).
Pe2: Model Affiliation: The black lines on the map labeled “Admiral St”, “Baker St”, “Cesar St”, “Dundas St”, “Elvis St” and “Fitzgerald St” as well as the lines between them and the distance of 10 cm are part of the model (i.e., they are part of the representing features of the map).
Pe3: Observation on the Model: The (shortest) connection of lines from the intersection of the lines labeled “Admiral St” and “Baker St” to the intersection of the lines labeled “Cesar St” and “Dundas St” which includes / passes the

intersection of the lines labeled “Elvis St” and “Fitzgerald St” (on the map *B*) is 10 cm long.
Pe4: Object Correspondences: The real counterpart of the intersection of the lines labeled “Admiral St” and “Baker St” on the map is the crossroads Admiral St / Baker St (where we are now). The real counterpart of the intersection of the lines labeled “Cesar St” and “Dundas St” is the crossroads Cesar St / Dundas St (where the pub is). The real counterpart of the intersection of the lines labeled “Elvis St” and “Fitzgerald St” is the crossroads Elvis St / Fitzgerald St. The real counterpart of the black lines connecting these three points on the map are the streets connecting the three crossroads. The real counterpart of a distance of 10 cm on the map is 1 km.
Pe5: Relation Correspondence: The real counterpart of the relation ‘distance’ on the map is (again) the distance.
Ce: Conclusion: Reality Statement: The (shortest) route from the crossroads Admiral St / Baker St (where we are now) to the crossroads Cesar St / Dundas St (where the pub is) which passes the crossroads Elvis St / Fitzgerald St is 1 km long.

The inference made in this argument is deductively valid. (And it is analytically valid if we leave out the analytically true definition of ‘isomorphic’.) The advantage of this extended, ideal version of the argument is to make the inferential validity clear. Its disadvantage is, of course, that it is long and laborious. The latter problem is resolved by an enthymematic and otherwise simplified version of this argument, which leaves out the isomorophy definition, the Model Affiliation premise, several of the Correspondence premisses and simplifies some formulations. The result could be this:

Ps1: Representation Relation / Isomorphy: B is a map of city *A* (with the scale 1:10,000).
Ps3: Observation on the Model: On the map the route from the crossroads Admiral St / Baker St to the crossroads Cesar St / Dundas St via the crossroads Elvis St / Fitzgerald St is 10 cm long.
Ps4: Object Correspondence: 10 cm on the map correspond to 1 km in reality.
Cs: Conclusion: Reality Statement: The route from the crossroads Admiral St / Baker St to the crossroads Cesar St / Dundas St via the crossroads Elvis St / Fitzgerald St is 1 km long.

The descriptions in the Observation Premise Ps3 and in the Conclusion Cs are still laborious. If the arguer has the map in front of herself and her addressee, she will say instead: Pss3: ‘We are here’, thereby pointing to a point in the map, continue with: ‘The pub is there’, thereby pointing to another point on the map, and then go on with: ‘This route …’, thereby following with her finger the respective lines on the map from the starting point to the destination, ‘… is 10 cm long’. And the conclusion may be reduced to: Css: ‘This means this route / route 1 / the route via the crossroads Elvis St / Fitzgerald St is 1 km long.’ I repeat, this possibility is given only if the map is present. As Dove (2016) rightly says, this indexical way of referring to the objects the argument is about does not change the substance of the inference (p. 5). But it moves us still further away from the ideal version, which makes the inferential relation fully transparent.

The exemplary argument reconstructed so far is only one elementary argument within the complex argument sketched by Dove about what is the quickest route to the pub. Other parts of the complex argument which are again appeals to visual models regard the number of crossroads to be crossed and the situation of pedestrian bridges. To proceed with the argument, further empirical information is needed, which cannot be read off the map but may be part of the common knowledge of the persons involved, namely walking speed and the (medium) time to be spent for crossing the various crossroads. The speed information together with the lenghts of the routes permits us to calculate the net walking times; adding the waiting times for the crossroads without pedestrian bridges finally leads to the gross walking times. The final piece of the argument is to establish the route with the shortest gross walking time. All these further parts, i.e., further elementary arguments, within the complex argument are analytically valid, hence deductively valid, if the empirical premisses and lemmata are supplemented by analytically true premisses. This means even the complex argument (if supplemented by the analytically true premisses) is deductive. For making it an argumentatively valid argument (which implies among others also soundness), of course, now the empirical premisses have to be true, and the fitting premisses have to be filled in (as required by the argument's structure, to make the inferences in fact deductively valid).

That the basic structure of the appeal to visual model is deductive may be surprising. But it is good news since this fact reduces this type of argument to one subform of a well-studied general class of arguments, for which the epistemological basis is clear, namely deductive logic with its transfer of the truth-value 'true' from the premisses to the conclusion. (The just stated deductive character of appeals to visual models presupposes that the premisses are not restricted by qualifiers. Such a restriction, however, may sometimes be necessary, in particular if the model is not precise or contains errors. In such a case the isomorphy premise could be weakened to a statistical proposition, saying that the relation of isomorophy holds only extensively, e.g., only for 99% of the representations, but not always. In this case the argument has to be transformed into a probabilistic argument with a probabilistic conclusion. But for probabilistic arguments we have epistemological analyses as well, which justify these arguments with the help of probability theory (cf. Lumer, 2011).) Having arrived at this point, no further epistemological analysis of the appeal to visual model is required. Hence we can now compare the epistemological analysis of the appeal to visual model with Dove's respective theory.

3. Comparing Dove's theory of appeals to visual models and the epistemological analysis

Dove's (2016) final argument scheme is:

> *Dove's* "*Appeal to Visual Model:*
> [PD1:] *Representation Relation*: R models O.
> [PD2:] *Reasoning On Model*: In R, r obtains.
> [CD:] *Conclusion*: In O, o obtains (where o is the feature represented by r in R)."
> (p. 6; insertions in square brackets by me, C.L.)

The proper scheme is complemented by the following critical questions:

> CQ1: "Is the representation / model adequate for the given reasoning?"
> CQ2: "Does the representation / model accurately portray the relevant relations?"

CQ3: “Is the result, r on R, properly attributed?”
CQ4: “Are there competing representations / models of O?” (Dove, 2016, p. 7)

Though Dove’s schematization of the appeal to visual models is an important step and progress I think it is still lacking in several respects.

1. What bothers me most is that his scheme does not represent a deductively or analytically valid inference, though, as has just been shown, appeals to visual models can be analyzed and reduced to deductive arguments. Without such a kind of reduction or an alternative foundation, which Dove however does not provide, the arguments and the argument scheme remain unjustified and their merits unclear. Why should we trust such an argument, i.e. believe the conclusion, if the premisses are fulfilled? Instead of providing such a justificatory reduction, Dove complements the scheme by the critical questions. But as in Walton’s approach, these critical questions cannot substitute an epistemological justification of the scheme (see below). (By the way, Walton developed his argumentation schemes approach with the critical questions for resolving the problem of uncertain arguments. If, however, appeals to visual models can be analyzed as deductive and therefore certain arguments, bringing in the argumentation schemes approach with the critical questions should be superfluous even in Walton’s terms. And it does not resolve the justification problem anyway.)

2. One could try to move on from Dove’s scheme to a deductively (or at least analytically) valid scheme by transforming the parenthesis in his conclusion CD into an additional premise: PD3: ‘r in R represents o in O.’ However, this would not yet suffice. First, the premise PD1 on the Representation Relation, that “R models O” is quite unclear. It should be analyzed and made precise in a way that also entails taking up the notion ‘*x* represents y’, now mentioned in PD3, and that, in the end, can make the argument deductively valid. This could be done by appealing to the isomorphy relation – as has been done in my epistemological analysis. Second, still a further premise, viz. on the model affiliation of what has been observed and is now described in premise PD2, would be missing. Third, the described model feature “r” usually is a state of affairs, i.e., an n-adic relation between objects. The bijective mapping of the isomorphy relation between reality and the model, however, is not primarily defined for states of affairs but for objects and relations, such that the counterpart of the state of affairs in the model has to be composed by relying on these more elementary mappings (cf. the premisses Pi4 on Object Correspondences and Pi5 on the Relation Correspondence in my own account).

3. A minor problem is that in Dove’s descriptions the meaning of “r” is not entirely clear. In the analyzed examples r sometimes is a mere observational statement—like “white line” in an x-ray (Dove, 2016, p. 5); on other occasions it seems to be already an interpretation—like: a certain route on the map “appears quickest” (p. 5). If r is an observation statement it remains unclear how the step from this observation to the realistic interpretation can be justified. If r is instead an interpreation it is not clear how this interpretation itself is justified.

4. Dove explicitly refuses to analyze appeals to visual models with the help of the isomorphy relation (Dove, 2016, p. 3). His reason for this refusal is: For most (non-scientific) purposes the isomorphism requirement would be too strong; models represent only some features of the original accurately (p. 3). Instead of the isomorphy relation he wants to rely on the similarity relation (p. 3). Perhaps the reason for rejecting isomorphism as the basis of his approach relies simply on a misunderstanding. Isomorphism does not imply that the original is *completely* reproduced; exactly to the contrary, the extension of the isomorphism can precisely be defined, such that e.g., houses or trees or park benches are excluded from the representation in

a map. The similarity relation, on the other hand, is much too unclear and vague as to be apt to provide the conceptual basis of a reconstruction of appeals to visual models which make their rationale clear. And the similarity relation is an understatement of what a real model claims to achieve. In refusing an analysis with the help of the isomorophy relation Dove exactly rejects what would be the basis for a precise reconstruction of appeals to visual models. Furthermore, often the model is *not* similar—at least in the everyday sense—to the represented reality: think e.g., of representing *time* in a two dimensional *space* with the help of a time bar with insertions of event descriptions, or a temperature curve over time, or the representation of atmospheric pressure over time by a pressure curve, or its spatial distribution by a map with isobars, or the representation of parental relations with the help of a genealogic tree.

5. Dove's critical questions help to be attentive to certain critical points in appeals to visual models. However, they do not clarify or guarantee the appeal's validity; and for the deductive reconstruction of the appeal they are superfluos. CQ1 asks for the model's adequacy to provide the required information. However, if the model is not adequate in this respect, the desired conclusion cannot be derived; a fortiori, no argument has to be assessed. (Or if, alternatively, the desired conclusion is inferred to nonetheless, either some premise is false or the conclusion is not valid. Both cases are captured by traditional criteria for good deductive arguments.) CQ2, whether the model accurately represents the relevant relations, is a question for the truth of the premise PD1 on the Representation Relation ('R models O'). Hence CQ2 and the answer to it do not provide anything new beyond the original argument; the question is only an invitation to carefully examine the premise. (One could interpret PD1 also differently, much weaker, as saying only that R models O in some way without implying the correctness of the model. In this case the answer to CQ2 would provide new information. But this information then should be included among the premisses in the first place.) CQ3 is rather unclear to me. Finally, CQ4, regarding competing models, is only a particular way to ask for the premisses' truth: If there is a *competing* model which, in addition, is also correct then the used model is not correct. And this means premise PD1 (on the representational relation) is false. Altogether, then, the critical questions and the answers to them do not provide anything new beyond the original argument—if this argument was valid and sound. Hence they do not provide something which can justify reliance on the inconclusive argument scheme.

These criticisms show that though Dove's theory of the appeal to visual model is an important progress it can still be improved. And I hope to have shown that the approach developed here is such an improvement since it does not have the problems just listed. However, my approach dismisses the Waltonian framework of argumentation schemes. Instead it is epistemological, i.e., it tries to provide a firm epistemological basis for the schematized type of argument 'appeal to visual model', which in this case is deductive logic.

References

Dove, I. J. (2016). On appeals to (visual) models. In P. Bondy & L. Benaquista (Eds.), *Argumentation, Objectivity and Bias: Proceedings of the 11th International Conference of the Ontario Society for the Study of Argumentation (OSSA), 18-21 May 2016*. Windsor, ON: OSSA.

Lumer, C. (2011). Probabilistic arguments in the epistemological approach to argumentation. In F. H. van Eemeren, B. Garssen, D. Godden & G. Mitchell (Eds.), *Proceedings of the 7th*

Conference of the International Society for the Study of Argumentation, 29 June – 2 July 2010, (pp. 1141-1154). Amsterdam: Rozenberg / Sic Sat. (CD-ROM)

Lumer, C. (2016). Walton's argumentation schemes. In P. Bondy & L. Benaquista (Eds.), *Argumentation, Objectivity and Bias: Proceedings of the 11th International Conference of the Ontario Society for the Study of Argumentation (OSSA), 18-21 May 2016*. Windsor, ON: OSSA.

Walton, D. N. (1996). *Argumentation schemes for presumptive reasoning*. Mahwah, NJ: Erlbaum.

Walton, D. N., Reed C., & Macagno, F. (2008). *Argumentation schemes* (1st ed.). Cambridge: Cambridge U.P.