Historical perspectives on forms of English dialogue

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Metodi e prospettive
Studi di Linguistica, Filologia, Letteratura

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Reasoning, Rhetoric and Dialogue in Galileo’s Mathematical Discourses
by Elisabetta Lonati & Kim Grego

1. The reception of Galilean thought in (Early) Modern England

This study analyses the two English versions of Galileo Galilei’s Discorsi e Dimostrazioni Matematiche, intorno a due nuove scienze (1638, henceforth Discorsi), issued in England in 1665 and in 1730 respectively. The first is a translation by Thomas Salusbury, Esq.; the second is by Thomas Weston, Master of the Academy of Greenwich. The topic, as reported in the title pages of both versions, is Two New Sciences concerning Mechanics and Local Motion (1665/1730). The new ideas and approaches to reality expressed in this work were «more favourably received […] by Englishmen than by men of any other nation outside Italy» (Drake 1999b: 236-237). It is no accident that, following the establishment of the Royal Society (1662), «many of Galileo’s books were published […] through the monumental labors of the mysterious Thomas Salusbury» (Drake 1999b: 247). Nor is it a coincidence that the two English translations preceded by far any other modern language version in Europe1.

1.1. The source text

The original manuscript of Galileo’s Discorsi was written some time between 1602 and 1637, during the life imprisonment following the Inquisi-

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* Elisabetta Lonati is responsible for paragraphs § 1, 1.2., 1.4., 1.5, 1.5.2, 2, Kim Grego for paragraphs § 1.1., 1.3., 1.5.1, 3., 4.

1. For a detailed discussion on Galileo Galilei’s works and language, with particular reference to the English translations, see Drake (1958, 1999a and 1999b); Gotti (2000); Zeitlin (1959).

tion's condemnation of his 1632 *Dialogo* [...] *sopra i due Massimi Sistemi del Mondo* (henceforth *Dialogo*). From the scientist's Tuscan captivity, his *Discorsi* reached the more tolerant Leiden, where they were first printed in 1638 (Drake 1980/2001: 104). The last and *most demanding of Galileo's books* (Swerdlov & Levere, in Drake, 1999a: xiii) is now acknowledged as having paved the way for modern physics from Newton to Einstein by addressing key physical-philosophical topics such as motion, the classical matter-vs.-void antithesis and infinity.

There is no ultimate evidence that the two English translations derive from the same Italian edition, if only because the two translators lived in different historical periods and a great amount of Galileo's works in Italian had been circulating in London since the end of the 17th century.

However, previous studies may suggest the opposite. For instance, a study carried out by Drake (1958: 26) on Salusbury's technique in his 1661 translation of Galileo's *Dialogo* (1632) highlights that 'in his own edition Salusbury was meticulously faithful to his original, and never edited out or deliberately omitted a word of Galileo's text'. The same approach to the original text of the *Dialogo* is also emphasised by Gotti (2000). He points out that Salusbury is extremely faithful in reproducing the source text at both the lexical and the morpho-syntactic levels:

the sentences are usually translated in a very similar form, and only minor alterations in word order or syntactic construction are made in order to satisfy specific rules which diverge in the two languages (Gotti 2000: 91).

Obviously enough, these remarks cannot be directly transferred to Galileo's *Mathematical Discourses and Demonstrations touching Two New Sciences* (1665, henceforth *Discourses*) as analysed here. Nonetheless, they is volume 72 of the Galilean manuscripts at the National Central Library of Florence. Into that volume were bound, in no discernible ordering, Galileo's working papers on motion from 1602 to 1637, the eve of publication of *Two New Sciences*.


4. Hawking (1988/1999: 199-200); «Galileo, perhaps more than any single person, was responsible for the birth of modern science. [...] It was this work, referred to as *Two New Sciences*, even more than his support for Copernicus, that was to be the genesis of modern physics».

5. For an in-depth discussion on the reception, translation and publication of Galileo's works in England, and London in particular, see Drake (1999b).

6. More examples may be found in the *Appendix*.
I see to proceed very scrupulously, and refuse to admit anything for certain, save that which they necessarily demonstrate. (pp. 74-75)

In the preface to his 1730 translation of Galileo's *Discorsi* (titled *Mathematical Discourses concerning Two New Sciences*, henceforth *Discourses*), on the other hand, Thomas Weston indicates as the reason why a new translation was "much desired and promoted" the fact that Mr Salusbury's version had by that time "become very scarce" (*Discourses*, Translator's Preface, TP, v). 'Scarcity', here, is to be understood as 'rareness', since the Great Fire of 1666 had destroyed a great amount of books, including Salusbury's (Drake 1999b, p. 247). Therefore, he adds, "In Consequence whereof I now make publick a Second Translation (done from Elzevir Edition of the Italian)" (*ibidem*), that is to say the same first edition issued in Leiden in 1638 which Salusbury translated in 1665 (see previous examples and Appendix for the Italian version).

Weston meant his second translation to be (as I presume my Friends expect it should be) neater, and more agreeable to the present Taste, and less obscure than the former [...] The only Objection to our Author, as I have heard of, is, that he is too prolix (Discourses, TP, vi-vii).

The first translation's obscurity and Galileo's own 'propinquity' urged Weston to adopt a completely different approach to Salusbury's and to adapt the original Italian text to contemporary taste.

*Weston's transl. 1730*

SALV. To this Sagredos answers; Altho' a Million of Gold suffices not to pay a whole Army, that yet each single Soldier may be paid with Monies collected from the general Tax or Subsidy of Shillings and Pence. (p. 28)

SAGR. This Speculation seems to me so curious, that I would not contradict it. methinks, tho' I could, for I take it for a kind of Sacrilege to deface so fine a Structure, or to trace, pursue, or examine it with any pedantic Remarks. But, however, for entire Satisfaction, pray give us the Demonstration, which you say is Geometrical, [...] (pp. 43-44)

SIMP. I can't say but I am please'd with the Method you talk of; and to your Question I reply. That I should think it more than sufficiently easy, if a Line could be as readily divided into Points, as into a thousand Parts. (p. 54)

SIMP. I am thoroughly satisfied, and, believe me, were I to begin my Studies again, I would follow Plato's advice, and begin with Mathematicks, which I see proceed with the utmost Caution, and refuse to admit any thing as certain but what they demonstrate. (p. 133)

All the above considerations lead us to believe that both the 1665 and the 1730 translations may be considered versions of the same 1638 first edi-

tion or, in other words, parallel versions of the same source text (though of course not necessarily of the same copy)?

Therefore, the object of this analysis will be the 1665 and the 1730 English versions considered as such, that is to say, as independent English texts belonging to, expanding upon and ultimately shaping Modern English scientific discourse.

1.2. Dialogue and discourse

Despite being titled *Discorsi [...] Matematici* (1638) and *Mathematical Discourses* (1665 and 1730), Galileo's work is in fact structured as a series of four dialogues. For this reason, before proceeding with the textual analysis, it may be interesting to explain the meanings of the pairs dia
ger
dialecto
discourse and discorso-discourse in the Italian and English lexicography of the time. A dictionary review can actually help clarify what these terms represented for Galileo and his Italian and English contemporaries.

The first and the second editions of the *Vocabolario della Crusca*, issued in 1612 and 1623 respectively, record the following meanings in two distinct entries:

**DIALOGO.** Scrittura in prosa, dove s'introducono più persone a discorrere, per via di domanda, e di risposta. [...] (Vocabolario, 1612)

**DISCORSO.** Operazione dello 'nletetto, con la quale si cerca d'intendere una cosa perfettamente, per mezzo di congiugature, o di suoi' principii noti. [...] (Vocabolario, 1612)

and

**DIALOGO.** Discorso di più persone. [...] (Vocabolario, 1623)

**DISCORSO.** Operazion dello 'nletetto, colla quale si cerca d'intendere alcun cosa perfettamente, per mezzo di congiugature, o di suoi principji noti. [...] (Vocabolario, 1623)

In a similar way, Early Modern English dictionaries record *dialogue* as a communication, reasoning or disputuon between two parties or more, or a written Discourse, where such a Conference is set down. (Blount, *Glossographia*, 1656)

and

a written discourse wherein two parties are brought in talking together. (Phillips, *The New World of English Words*, 1658).

7. A similar approach may be found in a recent study by Pahta et al. (2011: 178-196), concerning medical texts. See Bibliographical references.
In Early Modern English lexicography, the term *discourse* is not yet attested as a separate entry. The issue dates of both the Italian and the English dictionaries shortly precede the publication of Galileo’s *Discorsi* (1638) and Salusbury’s translation (1665). The meanings are similar in the two languages, except for some slight differences highlighted in the lexicographic entries. On the one hand, Mount (1656) and Phillips (1658) do not list *discourse* as a separate entry, even though its meaning is included in the entry *dialogue*, and it is used in the two definitions as a quasi-equivalent. On the other hand, the Italian *Vocabolario* (1612 and 1623) treats *dialogo* and *discorso* as independent lexical items and thus as two separate entries. At any rate, both the partial overlapping of their meanings and the quasi-equivalence of the two terms in this context support the rendering of the Italian title in English. Only later, in the first quarter of the 18th century, just before the publication of Weston’s translation (1730), are *dialogue* and *discourse* treated separately in English dictionaries. Starting with Kersey (1702) and later Bailey (1721 and 1730), *discourse* is included in the lemmata with the following definitions:

**A Discourse, speech, or talk.** (Kersey, 1702)

and

**DISCOURSE, [...] Reasoning, Speech, Talk.** (Bailey, 1721)

**DISCOURSE, [...] speech, talk, conversation, reasoning.** (Bailey, 1730)

At the dawn of Weston’s 1730 translation, *discourse* seems to focus on spoken interaction whereas *dialogue*, in the same dictionaries, highlights the structure of such interaction, especially as «a written discourse where two or more Parties are talking together» (Bailey 1721) or «a discourse in writing between two or more parties» (Bailey 1730)².

### 1.3. Aims of the study

The analysis of the two English versions of Galileo’s *Discorsi* aims at discussing the interaction between speech-related features and writing-related features of a scholarly conversation in dialogue form.

8. The core meaning of *dialogue*, as it was also attested in Early Modern English dictionaries, does not change in later works. However, it is worth noting a semantic narrowing since the beginning of the 18th century: «Dialogue, a feigned discourse between two or more Parties; or a written Discourse where two or more Parties are talking together» (Bailey 1721); «DIALOGUE, [...] a Conference or Discourse between two or more Parties; or a discourse in writing between two or more parties wherein they are represented as talking together» (Bailey 1730).

According to Culpeper and Kytö (2010: 17 passim), speech-related genres can be classified as *speech-like* (that is, containing «features that are speech-like»), such as personal correspondence, prose fiction with speech presentation, but also plays and handbook in dialogue form, etc.; *speech-based* (that is, containing features based on “real-life” speech events, such as trial proceedings, witness depositions with direct speech presentation, but also parliamentary records, etc.); *speech-purposed* (that is, genres «designed to be articulated orally», such as sermons and proclamations which are «designed to produce monologue», but also handbooks in dialogue form, plays, etc. Plays, in particular, are designed to produce real-time spoken interaction). On the contrary, *written-based* and *purposed* features characterize scholarly writing and prose fiction with no speech presentation. Moreover, Culpeper and Kytö (2010: 17-18) also maintain that «there is no reason why a text could not be speech-like, speech-based and speech-purposed. The multi-faceted life of texts can only be properly understood on a case-by-case basis».

In the context of the present analysis, speech-related features are meant as those linguistic-rhetorical aspects characterizing speech presentation and spoken interaction when these appear in written dialogue form, such as in:

**Salusbury’s transl. 1665**

SIMP. I can scarce refrain my laughery to see the great Antipathy that Salvianus hath to Antipathy, so that he will, not so much as name it. [...] 

SALV. Now let this, for the sake of Simplicius be the solution of our scruple; and leaving the Digression, let us return to our purpose. [...] 

SIMP. This is a bold speech, Salvianus, I shall never believe that in Vacuity it self, if so be one should allow Motion in it, a lock of Wool would move as swiftly as a piece of Lead. (p. 59)

**Weston’s transl. 1730**

SIMP. I can’t help laughing to see the great Antipathy Salvianus has to Antipathy; that he does not think it worth naming. [...] 

SALV. Well, for your Sake, Simplicius, let this solve our Doubt, and leaving this Digression, let us return to our purpose. [...] 

SIMP. How, Salvianus! You’ll never get me to believe, I think, that a Lock of Wool, and a Piece of Lead, would, even in a Vacuum, fall with the same Celerity. (pp. 106-107)²

9. Mi vien quasi da ridere nel veder la grande antipatia, che ha il Sig. Salv. Con l’antipatia, che ne pur vuol nominarla, [...]. SALV. Her sia questa in grazia del S. Simp. la soluzione del nostro dubbio; e lasciato il digredire torniamo al nostro proposito. [...] 

SIMP. Gran detto è questo S. Salv. Io non credèrò mai, che nell’istesso vacuo, se pur’ vi si desse il moto, un fiocco di lana si movesse così veloce come un’ pezzo di piombo. (*Discorsi*, pp. 72-73)
Whereas, writing-related features are meant as the linguistic-rhetorical aspects which characterize scholarly writing, such as:

Salisbury’s transl. 1665

SALV. In regard I see, that you are so well pleased with these Geometrical Demonstrations [...] I will give you the fellow to this, which satisfie to a very curious Question. [...] 

**PROPOSITION.**

Upon Cylinders, the Superficies of which the Bases being subtracted are equal, have the same proportion to one another as their heights Reciprocally taken

Let the Superficies of the two Cylinders $AE$ and $CF$ be equall; but the height of this $CD$ greater than the height of the other $AB$. I say, that the Cylinder $AE$ hath the same proportion to the Cylinder $CF$, that the height $CD$ hath to $AB$. Because therefore the Superficies $CF$ is equall to the superficies $AE$, the Cylinder $CF$ shall be lesse than $AE$: [...] (pp. 43-46)

Weston’s transl. 1730

SALV. Since I see you are so well pleased with Geometrical Demonstrations [...] I will give you the Fellow to this, which will answer a very curious Question often ask’d: [...] 

**PROPOSITION.**

Upright Cylinders, whose Surfaces, omitting the Bases, are equal, are in reciprocal Proportion to their Heights: Let the Surfaces of the two Cylinders $AE$ and $CF$ be equal, but let the Height of the one $CD$ be greater than the Height of the other $AC$. I say the Cylinder $AE$ has the same Proportion to the Cylinder $CF$, as the Height $CD$ has to the Height $AB$: For since the Surface $CF$ is equal to the Surface $AE$, the Cylinder $CF$ will be less than the Cylinder $AE$: [...] (p. 82)

Accordingly, the discussion will also verify whether there is a “shifting relationship” or, rather, a “shifting proportion” in the use of speech-related features and writing-related features in the two versions.

1.4. The structure of Galileo’s Discorsi

The characters involved are Salviati, Galileo’s voice, theorizing the new science and putting forward the new approach to reality; Sagredo, the new scientist, curious and imaginative, deeply interested in new hypotheses and experiments; and Simplicio, representing Aristotle and the Peripatetics but open to further debate, i.e. a figure representing a traditional scholar, who, despite his name, is “for most of the time a respectable opponent [...] He is therefore the antithesis of Galileo-Salviati” (Prova and Marenzana 2006: 52-53).

The Discorsi is arranged as four dialogues taking place over four distinct days each comprising a series of discussions on different topics. The general structure sees the alternation of the three characters with the personality of Salviati clearly emerging as the leading one.

1.5. Methodology and materials

The present study follows a qualitative approach in the analysis of the opening dialogue ("Concerning the Resistance of SOLIDS, against FRACTIONS") in both Discourses, and Discourses.

Due to the complex and multilayered nature of Galileo’s Discorsi, different theoretical tools and notions from pragmatics have been useful in supporting the analysis.

In the following sections the terminology adopted in this discussion is briefly defined.

1.5.1. Genre

The concept of genre is as old as western culture, coming down straight from Platonic archetypes and Aristotelian categories, and has acquired various specifications, connotations and formulations over the centuries. In modern times, categories were reviewed by Kant in *Critique of pure reason* (1781), Wittingenstien changed his view of categories into prototypes as “family resemblances” (1953), Derrida supported the thought that all texts belong to one or more certain (textual) genres (Derrida and Ronell 1980). Contemporary linguistics developed the notion further to cater for specialized communication, for instance Bhatia (1993: 13) defining it:

10. SALV. Già che veggo, che gustate tanto di queste Geometriche dimostrazioni [...] vi dirò la compagnia di questa, che sodisfa ad un quesito curioso assai. [...] 

I Cilindri retti, le superficie de i quali trittone le basi siano eguali, hanno fra di loro la medesima proporzione che le loro altezze contrariamente prese.

Siano eguali le superficie de i che Cilindri $AE$, $CF$, ma l’altezza di questo CD maggiore dell’altezza dell’altro $AB$. Dico che Cilindro $AE$ il Cilindro $CF$ ha la medesima proporzione, che l’altezza $CD$ alla $AB$. Perche dunque la superficie $CF$ è eguale alla superficie $AE$, sarà il Cilindro $CF$ minore dell’$AE$, [...]. (Discorsi, p. 56).

11. For a detailed discussion on the roles and tasks in conversation, as well as the distribution of interactional features, see Iakura (2001) and section 1.5 Methodology and materials.

12. This is title for the first dialogue in the 1730 Weston’s translation, and it corresponds to the Italian «Scienza nuova prima, intorno alla resistenza dei corpi solidi all’essere spezzati. Giornata prima». Salisbury’s first dialogue is not titled.
a recognizable communicative event characterized by a set of communicative purpose(s) identified and mutually understood by the members of the professional or academic community in which it regularly occurs. Most often it is highly structured and conventionalized with constraints on allowable contributions in terms of their intent, positioning, form and functional values.

and Swales (1990: 58), specifying that

exemplars of a genre exhibit various patterns of similarity in terms of structure, style, content and intended audience. If all high probability expectations are realized, the exemplar will be viewed as prototypical by the parent discourse community.

The genre considered here is somewhat closer to the earlier concept of literary genre or, in Fairclough’s words, pre-genres are:

highly abstract ‘pre-genres’ such as Narrative or Report which generalize over many different forms of narrative or report at a more concrete level.

Here, though, Swales’s more specific view of pre-genre will be adopted, in which “conversation” is a precursor of all genres written and spoken, and as such it «represents a pre-genre for dialogue» (Cramer 2011: 57).

1.5.2. Conversation analysis

That is the study of conversation, simply put. In more detail, it is the discipline established starting from and owing to Schegloff et al. (1974) article on turn-taking in conversation. The tools it employs derive from various other fields of study apart from linguistics, including psychology and ethology. Within linguistics, the focus is definitely pragmatic, and – as intended here – it is not limited to turn-taking alone, but extends to sociolinguistic and discursive considerations, like that of repair.

1.5.3. Repair

The general notion of repair is taken from Conversation Analysis and means a kind of "correction" of some portion of text to avoid ambiguity and misunderstanding in the «sequential organization of conversation, specifically in turn-taking system» (Schegloff eta al. 1977: 362). Actually, the notion of repair is more articulated and complex than that of «replacement of an ‘error’ [...] by what is ‘correct’» (Schegloff et al. 1977: 363), because repair may include not only replacing but also repeating, recycling, substituting, adding, inserting, etc. words, phrases and clauses, and «can describe more than one type depending on the component that it affects» (Riegel 2003: 50). The repair procedure partially overlaps with the notion of reformulation. However, reformulation here refers to single turns considered in isolation, so it is no specific conversational feature. Repair, on the other hand, as speech activity, focuses on interaction across subsequent turns and is explicitly elicited by interlocutors requesting repair. The notion, here, does not obviously apply to spontaneous interaction but to fictional scholarly conversation and written discourse. Reformulation is a linguistic strategy used to rewrite an expression or a longer portion of text in order to clarify and explain its original (theoretical) contents. In other words, it is a simplified version of difficult passages for a non-expert – or a less expert – readership. The explanation may also be associated and expanded with anecdotes from real life experience (see Ex. 1).

Conversational dominance refers to the asymmetry characterizing the exchange structure, the development of turn-taking and the alternation of assigned roles in conversation (such as expert vs. non-expert). In other words, conversational dominance refers to «a multi-dimensional construct» (Itakura 2001: 1862) in which one speaker controls other participants both from a sequential and quantitative viewpoint. Sequential means «the tendency for one speaker to control the direction of an interaction» (Itakura 2001: 1864), whereas quantitative refers to the space «each speaker [...] occupies in the sequence» (Itakura 2001: 1870), both as regards the average turn length and the number of words spoken (ibidem).

2. Galileo’s conversational strategies

2.1. Reformulation and repair

Galileo’s scientific exposition follows a meta-linguistic approach characterized by a great variety of rhetorical and stylistic strategies. These aim at

13. The expansion of the repair notion «to handle all discourse» draws on Roberta Piazza’s analysis of play discourse (1999: 1006 ff.). Both the structure of the exchange – [...] the canonical types of requests for repair of the literature on conversational analysis – and the pragmatics of conversation have been considered (Piazza 1999: 1006). In her opinion «any conversational move [...] can be sequentially implicated with the preceding and the following turns and thus can function as a trigger for repair work. Thus both in natural conversation and in dramatic discourse an infinite variety of signals exists which determine self-correction» (ibidem).

14. For a general discussion on this topic see also Troeltsch (1994).
asserting «the possibility of discoursing in everyday language about problems that traditionally had always been dealt with by recourse to technical jargon» (Drake, 1999a: 51). Science, however, cannot be generically reduced to everyday experience, but in exposing science the world of experience and shared knowledge may help «avoid [...] a mere word on paper» e.g. «the artificial vocabulary of philosophers» (Drake, 1999a: 51). The world of experience and the world on paper alternate in Galileo's scientific exposition through his use of reformulation. The following excerpts exemplify the approach in the two English versions under scrutiny here15. The two interlocutors are Salviani, representing Galileo's voice and Sagredo, the curious and imaginative scholar:

Example 1 – Scientific exposition by reformulation

<table>
<thead>
<tr>
<th>Salisbury 1665 (pp. 8-9)</th>
<th>Weston 1730 (p. 13 ff.)</th>
</tr>
</thead>
</table>
| SALV. [...] let AB and CD be two cylinders (1), and between them let there be distended (3) the thread (1) EF, which for greater plainness I will represent to be a small Cord (1); there is no doubt but that the two Cylinders (1) being pressed (2-3) hard one against the other, the Cord (1) EF pulled by (2-3) the end F will resist no small force before it will slip (6) from between the two Solids (1) compressing it (2); but if we remove (6) one of them, though the Cord (1) continue touching the other (1), yet shall it not by such contact be hindered (3) from slipping (2) away. But if holding (2) it fast, though but gently in the point A, towards the top of the Cylinder (1), we wind (6), or belay (6) it about the same (1) spirally (1) in AFLOTR, and pull (6) it by the end R: it is manifest, that it will begin to press (2) the Cylinder (1), and if the windings (1) and wreaths (1) be many, it shall in its effectual drawing always press (6) it so much the straiter about the Cylinder (1): and by multiplying (2) the wreaths (1) if you make (6) the contact longer, and consequently more invincible, the more difficult still shall it be to with draw (2) the Cord (1), and make it yield to the force (1) that pulls it. Now who sees not, that the same Resistance (1) is in the threads (1), which with many thousand such twinnings (1) spin the thick Cord (1)? [...] SAGR. Your (4) discourse hath removed (5-6) the wonder out of my mind at two effects (1), [...] the other (1) is at a plain, but cunning Instrument found out (2-3) by a young Kinsman of mine (4), by which with a Cord (1) he could let (5-6) himself (4) down from a window without much gauling (2) the palms of his (4) hands, as to his (4) great skill not long before he (4) had done (5-6). For the better understanding whereof take (5-6) this Scheme:

About such a Cylinder (1) [...] two Inches thick, and six or eight Inches long, he (4) cut (5-6) a hollow notch spirally, for one turn and a half and no more, and made (5-6) it so as to be just wide enough to enter (2) through the notch [...] entered (2) afterwards the Cylinder (1) in a barrel or socket of Wood, or rather Tin, but divided (2-3) lengthways, and made (2-3) with Clapses or Hinges to open and shut (2) at pleasure, and then grasping (2) and holding (2) the said Barrel or Case with both his (4) hands, the rope (1) being made (2-3) fast above, he (4) hung (5-6) by his (4) arms; and such was the compression of the Cord (1) between the moving Socket and the Cylinder (1), that at pleasure gripping (2) his (4) hands closer he (4) could stay (5-6) himself (4) without descending (2), and slipping (2) his (4) hold a little, he (4) could let (5-6) himself (4) down as he (4) pleased (5-6).

SALV. [...] Let AB and CD be two Cylinders (1), and between them, let there be extended (3) a Thread (1), which, for greater Plainness, we shall represent by the small Cord (1) EF. Now there's no doubt but these two Cylinders (1) being pressed (2-3) hard against each other, the Cord (1) EF, pulled by (2-3) the end F, has a great Force to resist, before it can be drawn (3) from between the two Solids (1) which compress (5-6) it. But if one of these Cylinders (1) be removed (3), though the Cord (1) still touches the other (1), yet shall it not by such contact be hindered (3) from slipping (2) away; but if holding (2) it fast, though but gently in the point A, towards the top of the Cylinder (1), we wind (6), or belay (6) it about the same (1) spirally (1) in AFLOTR, and pull (6) it by the end R: it is manifest, that it will begin to press (2) the Cylinder (1), and if the windings (1) and wreaths (1) be many, it shall in its effectual drawing always press (6) it so much the straiter about the Cylinder (1): and by multiplying (2) the wreaths (1) if you make (6) the contact longer, and consequently more invincible, the more difficult still shall it be to with

SALV. [...] An ingenious invention verily [...].
Before analysing reformulation, in Sagredo’s turn, it is worth looking at Salviati’s preceding argumentation. Salviati expounds his scientific theory focusing on the experiment reported. The steps of the process described are clearly and discursively highlighted, avoiding rhetorical ornaments. Salviati’s exposition is characterized by textual cohesion and depersonalization, expressed through linguistic features such as lexical repetitions (1), non-finite verbs (2), the passive voice (3).

Sagredo formally follows Salviati’s turn, but he actually introduces his own independent discourse, that is his reformulation (Sagr. Ex. 1). Sagredo aims at popularizing the topic of the ongoing discussion: the incipit of this turn could actually be reduced to the linking formula «in other words», introducing the reformulated version for a non-expert readership. The recourse to Sagredo’s personal experience is a clear strategy – mostly used throughout the dialogue – to transform the world on paper into the sensible world of shared knowledge, understandable by the layman. The popularization starts at «For the better understanding whereof take this Scheme» (Discourses), «And that you may the better understand this, take the following Scheme» (Discourses), Sagredo, Ex. 1 above. The attention is now focused on «a young Kinsman of mine» (Discourses), and not strictly on the (scientific) process as in the preceding turn. The shift from a written-related dimension to a speech-related one emerges from both the preference for linguistic features typical of personalization, like personal deixis (4), finite verbs (5), the active voice (6), and the frequency of their use.

If Sagredo is the supporter of Salviati-Galileo’s thought, his formal turn may also be considered as a kind of repair triggered by Salviati’s explicit request «who sees not, that the same Resistance is in the threads [...]?» (Discourses), «who does not see that the same Resistance is in the Threads [...]?» (Discourses), structurally placed at the end of his turn. Sagredo’s repair starts with «a plain, but cunning Instrument found out by a young Kinsman of mine» (Discourses), «a simple, but clever Instrument, invented by a young Kinsman of mine» (Discourses), and it is later emphasised by a more formal «For the better understanding whereof » (Discourses), «And that you may the better understand this » (Discourses), clearly replying to Salviati’s trigger-query, see Ex. 1. Galileo does double himself, putting forward two different fictional characters: Galileo’s thought – i.e. his outlook on reality and his scientific knowledge – is structurally transformed into two dramatis personae with partially overlapping functions.

The Salviati-Sagredo repair strategy corresponds to the alternation between scholarly and popularizing exposition, indeed, as Piazza (1999) states «what really characterizes dramatic and fictional discourse in general is that, while apparently focusing on the interpersonal plane, it actually aims at conveying a specific meaning and message». This is obviously the case with Galileo’s ideas as exposed in his Discorsi.

Also consider the following example:

Example 2 – Conversational repair

<table>
<thead>
<tr>
<th>Salisbury 1665 (pp. 31-32)</th>
<th>Weston 1730 (p. 59-60)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SALV. [...] And whilst that breaking a Solid into many pieces, and pursuing to reduce it into very small powder, it were resolved into its infinite Atomes, admitting no farther division, why may we not say (7) that it is returned into one sole Continuum, but perhaps fluid, as the Water, or Quicksilver, or other Metals melted? And do we not see (7) Stones liquefied into Glass, and Glass itself with much Fire to become more fluid than Water?</td>
<td>SALV. [...] whilst we breaking any Solid to Pieces, and endeavouring to reduce it into the smallest Dust, when it is resolved into Particles admitting farther Division; why may we not say (7), that it is returned into one Continuum, but perhaps fluid, as Water is, or Mercury, or melted Metal? And do we not see (7) Stones liquefied into Glass, as also Glass itself, with a vast Heat, to become as fluid as Water?</td>
</tr>
<tr>
<td>SAGR. Should we therefore think (7) Fluids to be so called, because they are resolved into their first, infinite, indivisible compounding parts?</td>
<td>SAGR. Must we then believe (7) Fluids to be so called, because they are resolved into their first, infinite, indivisible, compounding Parts?</td>
</tr>
<tr>
<td>SALV. I know not how to find a better answer to resolve certain sensible appearances, amongst which this is one; When I take a hard Body (7), be it either Stone, or Metal, and with a Hammer, very fine File, endeavour to divide it, as much as is possible, into its most minute and impalpable powder; it is very clear, that least Atomes, albeit for their smallness they are imperceptible, one by one, to our light and touch; yet they are quantitative, figured, and numerable: [...].</td>
<td>SALV. I don’t know how better to account for many sensible Appearances, of which this is one. When I take any hard Body (7), for example, a Stone, or Piece of Metal, and, with a Hammer, or very fine File, divide it, as much as possible, into the finest and most impalpable Powder, ‘tis manifest that its most minute Particles, altho’ they are singly so small as to escape our Sight, yet are they quantitative, figured, and numerable: [...].</td>
</tr>
</tbody>
</table>

Conversational repair, in Ex. 2, may be seen in the flow of the argumentation conducted through a trigger-repair structure (7). At the end of his turn, Salviati formulates two questions to verify the effects of his exposition on his interlocutors «why may we not say [...] And do we not see [...]?» (Discourses), Sagredo answers both by making clear that he has understood Salviati’s argumentation and, at the same time, by formulating a new request «Should we therefore think Fluids to be so called, because [...]?» (Discourses), and «Must
we then believe Fluids to be so call’d, because [...]’’ (Discourses). Salviati’s repair starts at ‘I know not how to find a better answer’ (Discourses), and ‘I don’t know how better to account for’ (Discourses) and introduces further developments in the discussion: ‘When I take a hard Body [...]’ (Discourses).

Both in Ex. 1 and Ex. 2 the flow of the argumentation is triggered by explicit requests of repair. In Ex. 1, though, these give rise to reformulation, whereas in Ex. 2 they produce expansions (7) by which the argumentation progresses.

2.2. Control dominance

Another interesting key point to discuss is control dominance in conversation. In the case of the Galileo’s dialogue control dominance focuses on turn-taking development.

In particular, as the dialogue progresses, the different roles assigned to the participants define themselves, along with the functions and the goals of the three interlocutors. This often implies asymmetrical relationships.

In the following dialogue, control is attained through sequential dominance (control on the direction of interaction) and quantitative dominance (space each interlocutor occupies in the sequence), see § 1.5. Both are emphasized in the text as (8)-sequential and (9)quantitative. However, sequential dominance is also marked by personal deixis, especially I (8) vs. you (8); whereas we (8) refers to scholars/human beings and is mostly used to narrow the gap between interlocutors. Here, Salviati and Simplicio discuss infinity and indivisibility:

Example 3 – Control dominance

Salisbury 1665
(pp. 25-26)

Weston 1730
(pp. 45-48)

SALV. You (8) shall have some of my (8) particular thoughts thereon (8); first repeating what but even now I (8) told you (8), namely, that (8) Infinity alone, as also Indivisibility, are things incomprehensible to us (8); now think how they will be conjoined together (8) [...] (9)

SIMP. Here already rise a doubt, which I (8) think unanswerable: and it is, that we (8) being certain to find Lines one bigger than another, although both contain Infinite Points, we (8) must of necessity confess, that we (8) have found in the same Species a thing bigger than infinite; [...]. Now this assigning of an Infinite bigger than an Infinite is, in my (8) opinion, a conceit that can never by any means be apprehended.

SALV. These are some of those difficulties, which result from the Discourses that our finite Judgements make about Infinites, giving them those attributes which we (8) give to things finite and terminate; which I (8) think is inconvenient (8); [...] for proof of which there comes to my (8) mind a Discourse, which the better to explain, I (8) will propound by way of Interrogatories to Simplicius that started the question (8). I (8) suppose that you (8), very well understand which are Square Numbers, and which not Square. (8) (9)

SIMP. I (8) know very well, that the Square Number is [...] (9)

SALV. Very well: And you (8), I (8) know also, that (8) as the Products are called Squares: the Productors [...] are called Sides, or Roots; and the others [...] are not Squares. So that if I (8) should say, (8) all Numbers comprehending the Square, and the not Square Numbers, are more than the Square alone, I (8) should speak a most unquestionable truth: Is it not so? (9)

SIMP. It cannot be denied. (9)

SALV. Further questioning, if I (8) ask you (8), how many are the Numbers Square (8) you (8) can answer me (8) truly, that (8) they be as many, as are their proper Roots; since every Square hath its Root, and every Root its Square, nor hath any Square more than one sole Root, or any Root more than one sole Square.

SIMP. True. (9)

SALV. But if I (8) shall demand how many Roots there be, you (8) cannot deny but that (8) they be as many as all Numbers, since there is no Number that is not the Root of some Square: And this being granted, it is requisite to affirm (8) [...] (9)
The alternation of the two characters shows, on the one hand, the approach used by Salviati to deliver his knowledge: “by way of Interrogatories to Simplicius that started the question [...] Further questioning, if I [...] (Discourses) and ‘by way of Interrogatories to Simplicius, who started the Difficulty [...] If I go on with you’ (Discourses). On the other hand, his questioning and explanatory techniques also highlight Simplicio’s reasoning process and appreciation for the new method and results, as clearly expressed in subsequent turns: “Here already raiseth a doubt [...] I know very well, that [...] It cannot be denied [...] True (Discourses) and ‘Here already arises a Doubt [...] I know very well that [...] Most certainly [...] Very true’ (Discourses). The conclusion of the argumentation, reinforcing the validity of the process and the results thus obtained, is summed up in Salviati’s words “And this being granted, it is requisite to affirm” (Discourses) and “And this being granted, we may likewise affirm” (Discourses).

In the Discorsi, Salviati is undoubtedly the advocate of Galileo’s thought and the final arbiter of his communicative strategy. As a matter of fact, at the level of the exchange, one speaker [Salviati] may ask a question while the other [Simplicio] answers. In each case, the asymmetry consists in one speaker’s control over the interactional contribution of the other, Itakura (2001, p. 1862).

However, meanings and contents are the results of interaction, not the outcome of imposition, since the control dominance device functions only, and only if, a mutual agreement is established and maintained between participants, whichever their role(s) and task(s): “the development of the conversation [...] is actualised or successful only when it is accepted by the other speaker through a complying action that is constrained by the previous speaker’s action” (Itakura, 2001, p. 1862). Hence, Salviati-Galileo’s thought may be guaranteed by both Simplicio’s own discourse and his (inter)personal – but also (inter)actional, conversational and intellectual – disposition to compromise.

3. The shift towards speech-related features

Scientific exposition – as seen – is certainly one key aspect defining these texts’ rhetoric, although it is not the only one, or not one that can be discussed without also considering other rhetorically relevant features. Thus, moving away from the expository and deeper into the dialogic, the following analysis will take into account what strategies are employed to initiate, unfold and develop argumentations, between the constructed and the spontaneous.

3.1. Cohesive interplay

In the excerpt from Ex. 4 below, there are three subsequent conversational turns. It is interesting to look at how each ends and how the argumentation continues and is brought forward into the next turn.

Example 4 – Cohesive Interplay

<table>
<thead>
<tr>
<th>Galileo 1638 (p. 6-ff.)</th>
<th>Salusbury 1665 (pp. 5-ff.)</th>
<th>Weston 1730 (pp. 7-ff.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAGR. [...] I’uno più grosso il doppio dell’altro, quello non reggerà non solamente doppio peso di questo, ma triplo, e quadruplo.</td>
<td>SAGR. [...] the one twice as thick as the other, that shall bear a weight not only double to this, but triple, and quadruple.</td>
<td>SAGR. [...] the one twice as thick as the other, that shall bear a Weight, not only double, but triple, may quadruple of this.</td>
</tr>
<tr>
<td>SALV. Dite pur’ottupulo, nè direte lontano dal vero: nè questo effetto contraria a quello, ancor che in sembianze appaia così diverso.</td>
<td>SALV. You may say octuple [...] though in appearance it seems no different.</td>
<td>SALV. You may say octuple [...] at first Appearance, it seems so Difficult.</td>
</tr>
<tr>
<td>SAGR. Adunque Sig. Salviati spianateci ques-ti scogli, e dichiaratoci queste oscurità, se ne havete il modo [...] e se vi contentate, che questo sia il soggetto dei nostri ragionamenti di oggi, e me, e credo, al Sig. Simp. Sarà gratissimo.</td>
<td>SAGR. Therefore, Salvia-tius, explain unto us these Riddles, and level us these Rocks [...] if you be content that this be the subject of our this-dates discourse, it will be to me, and I believe to Simplicius, very acceptable.</td>
<td>SAGR. Therefore, Salviati, remove these Doubts, and explain to us these Difficulties [...] And if you please to let this be the subject of To-Day’s Discourse, you’ll much oblige us both.</td>
</tr>
<tr>
<td>SALV. Non posso mancar di servirle [...]</td>
<td>SALV. I cannot refuse to serve you [...]</td>
<td>SALV. With all my Heart [...]</td>
</tr>
</tbody>
</table>

The topic being discussed (important when evaluating scientific exposition), when focusing on cohesion, is actually irrelevant: even without knowing it, it is plain, just from the highlighted words, how the interplay progresses. Sagredo concludes the first turn-taking by saying «double», «triple», «quadruple». Salviati immediately resumes it by adding: «octuple». Here the cohesion is provided through a logical
reasoning sequence, expressed through basic but specific mathematical lexicon.

In the second turn-taking, the cohesive interplay is lexico-semantic. The key words closing the second turn are «different» (Discourses) and «difficult» (Discourses) already pointing to two dissimilar concepts. However, the ones opening the third turn are «riddles» and «rocks» (Discourses), and «doubts» and «difficulties» (Discourses). The lexical connection is not apparent in Discourses, where the “difference” develops into «riddles» (which may relate to Discourses, “difficulty” but hardly to Discourses, “difference”) and «rocks», unless the reasoning refers to how “different” «riddles» and «rocks» are. However, this is not the case, and a look at the coherence or logical connection between turns confirms that. In Discourses, on the other hand, the connection is there at both the cohesive and the coherent level, since «difficult» points openly to «doubts» and «difficulties», and the already plain link is made even plainer – obvious, even – by the repetition, with morphological variation, of the same word («difficult» / «difficulties»). Also to be noted is the alliteration that is offered in the Discourses, («riddles» and «rocks»), and kept and even expanded to include the element in the previous turn in Discourses, («difficult» / «doubts» and «difficulties»), thus reinforcing the interplay at the cohesive level. However, it is significant that the metaphorical meaning (the mysteries and asperities hidden in «riddles» and «rocks») is lost, however, in the second version. It appears to be a clear indication that in 1730 science is no longer to be expressed through (opaque) metaphors i.e. literally, but in plain, crystal-clear (if bare) English.

Finally, the passage between the third and the fourth turnings is signposted by the request made to Salvioni to explain the “different” Discourses, “difficult” Discourses, concept, which he gladly meets. All this is realized through conversational expressions («it will be to me, and I believe to Simplicius, very acceptable», Discourses, «you’ll much oblige us both», Discourses,) creating an implicit question-and-answer interplay. This is, however, very different from the plain, classical question-and-answer (Di Martino 1993 and Trostberg 1994) structure of earlier didactic manuals16. What differs between the two texts are the syntactic structures expressing the interplay, more articulated in Discourses, more concise in Discourses.: «if you be content» (stative verb + adjective, description of state, written-related) vs. «And if you please» (action verb, active participation, speech-related); «I cannot refuse to serve you» (sentence, written-related) vs. «With all my Heart» (utterance, speech-related).

Other dialogic passages highlighting a shift from more obviously written-related features to speech-related ones are reported in Ex. 5 below.

Example 5 – From written-based related to speech-related mimetis

<table>
<thead>
<tr>
<th>1. Galileo 1638 (p. 21)</th>
<th>Salisbury 1665 (p. 17)</th>
<th>Weston 1730 (p. 30)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAGR. No, quando quel metallo fusse una mole infinita: altrimenti.</td>
<td>SAGR. Not if the metal were of an infinite mass; otherwise –</td>
<td>SAGR. Not if the Mass of Metal was infinite: But otherwise –</td>
</tr>
<tr>
<td>2. Galileo p. 31</td>
<td>Salisbury 1665 (p. 25)</td>
<td>Weston 1730 (p. 45)</td>
</tr>
<tr>
<td>SALV. Havrò qualche mio pensiero particolare.</td>
<td>SALV. You shall have some of my particular thoughts thereon;</td>
<td>SALV. I will give you my particular Sentiments of that too;</td>
</tr>
<tr>
<td>3. Galileo p. 89</td>
<td>Salisbury 1665 (p. 109)</td>
<td>Weston 1730 (p. 130)</td>
</tr>
<tr>
<td>SALV. Risolverò congiuntamente tutto quello che oppone.</td>
<td>SALV. I will resolve all that which you object in one word.</td>
<td>SALV. I’ll answer all your Objections at once.</td>
</tr>
<tr>
<td>SIMPL.: Io non capisco bene, come si deva intendere questo negozio.</td>
<td>SIMPL. I do not apprehend very well, how this business should be understood.</td>
<td>SIMPL. I don’t understand this.</td>
</tr>
<tr>
<td>5. Galileo p. 89</td>
<td>Salisbury 1665 (p. 111)</td>
<td>Weston 1730 (p. 131)</td>
</tr>
<tr>
<td>SALV.: E questo confermo io,</td>
<td>SALV. And this I confirm;</td>
<td>SALV. Right;</td>
</tr>
</tbody>
</table>

In particular, Ex. 5.1, apart from losing the third-person singular subjunctive form «were» in favour of «was», anticipates the specification from the predicate to the subject, thus creating a loaded thematic element that is followed by a lighter – i.e. more incisive – theme. Ex. 5.2 mimics speech by exchanging subject and object so as to have «I» (as expected in speech) as the subject; «will» substitutes «shall» as a deontic. Ex. 5.3 shows some dramatic syntactic simplification, with the deletion of the relative nexus, the normalization of «to object» into «objection», the three-word prepositional phrase substituted by a two-word adverbial, the choice of the Germanic

These popularizing section-turns, usually delivered by Sagredo, parallel Salviati's exposition and balance the underlying difficulty of scholarly writing.

Sagredo's main function is to reformulate Salviati's turns; he adapts written-based features to speech-related needs, as well as to the layman's cognitive skills (reformulation and conversational repair).

The alternation between Salviati (obviously displaying control dominance), Sagredo and Simplicio corresponds to a popularization need. The speech-related utterances such as «An ingenious invention verity» Discourses, and «An ingenious invention truly» Discourses, (Salv. Ex. 1), seem to reinforce the conversational aspect.

The comparison between the Discourses, and Discourses, was the occasion for further reflections on the changing aspects of language. The analysis of compared examples from the Discourses, and the Discourses, highlights a probable shift in lexicon, syntax, textual and rhetorical organization mirroring the evolution of English scientific discourse between 1665 and 1730 as attested in the two texts.

4. Final remarks

The dialogue has always been a relevant tool in discussing the most different topics in any domain. Galileo's approach to reality and, particularly, his scientific thought are thus outlined and conveyed by this versatile and articulated device: a useful discursive strategy to transform the "world on paper" into concrete evidence and shared experience that the educated non-expert interlocutor(s) could actually understand. The conversational strategies (reformulation, repair, conversational dominance) are integrated with the rhetorical features belonging to the form and function of traditional dialogue (cohesive interplay, written-related vs. speech-related features). In other words, the speech-related conversational scaffolding expands to include written-based genres such as the scientific treatise, along with popularizing sections.


Kant, I. (1781) [1835], *Critique of Pure Reason*, transl. by J.M.D. Meiklejohn, Bohn, London.


Appendix: The 1638 Italian text

5.1. On the resistance of solids (Ex. 1)

SALV. [...] e questi AB, CD siano due Cilindri, e tra essi disteso il filo EF, che per maggior chiarezza lo figureremo essere una cordicella: non è dubbio che premendo gagliardamente i due Cilindri l'uno contro l'altro, la corda PE tirata dall'estremità F resisterà a non piccola violenza prima che scorrerà tra i due solidi compimenti: ma se rimuoveremo uno di loro, la corda benchè continui di toccar l'altro, non però da tal toccamento sarà ritenuta, che liberamente non scorrà. Ma se ritenendola benchè debolmente attaccata verso la sommità del Cilindro A l'avvolgimento intorno a quello a foggia di spira APLOTR,
e dal capo R la tireremo: è manifesto, che ella comincerà a stringere il Cilindro, e se lè spire, e volte saranno molte, sempre più nel validamente tirare si comprimerà la corda addosso al Cilindro; e facendosi con la moltiplicazione delle spire più lungo il toccoamento, & in conseguenza men superabile, difficile si farà sempre più lo scorere della corda, e l’acconsentir alla trente forza. Hor chi non vede, che tale è la resistenza delle filamenta, che con mille, e mille simili avvolgimenti il grosso canapo contessono? […]

SAGR. Cessa per il tuo discorso nella mia mente la meraviglia di due effetti, […].

L’altro è d’un semplice ma arguto ordigno trovato da un giovane mio parente per poter con una corda calarsi da una finestra senza scorrersi crudelmente le palme delle mani, come poco tempo avanti gli era intervenuto con sua grandissima offesa. Ne farò per facile intelligenza un piccolo schizzo. Intorno a un simil Cilindro […] grosso, come una canna, e lungo circa un palmo incavò un canaleto in forma di spira di una volta, e mezzo, e non più, e di larghezza capace della corda, che voleva adoperare; e questa fecè entrare per il canale […] circondando poi tal Cilindro, e corda con un cannone pur di legno, ovvero anco di latta ma diviso per lungo, & ingangherato, si che liberamente potesse spirarsi, e chiudersi: & abbracciando poi, e stringendo con ambe le mani esso cannone, raccomandata la corda à un fermo risegno di sopra, sì sospense sulle braccia, e riusci tale la compressione della corda tra’ cannone ambiente, & l’Cilindro, che ad arbitrio suo stringendo fortemente le mani poteva sostenersi senza calare, & allentandole un poco si calava lentamente à suo piacimento.

SALV. Ingegno veramente invenzione, […]. (pp. 9-11)

5.2. Conversational repair (Ex. 2)

SALV. […] E mentre che rompendo un solido in molte parti, e seguendolo di ridurlo in minitissima polvere, risoluto che si fusse negl’infiniti suoi atomi con più divisibili, perché non potremmo dire quello esser ritornato un solo continuo, mà forte fluido, come l’acqua, o l’mercurio, o l’medesimo metallo liquefatto? E non vediamo noi le pietre liquefarsi in vetro, & l’vetro medesimo co’l molto fuoco farsi fluido più che l’acqua? SAGR. Doviamo dunque credere i fluidi esser tali, perché sono risoluti ne i primi infiniti, indivisibili suoi componenti?

SALV. Io non so trovar miglior ripiego per risolvere alcune sensate apparenze, tra le quali una è questa. Mentre io piglio un corpo duro è sia pietra, & metallo, e che con martello, è sottissima lima lo vô al possibile dividendo in minutissima, & impalpabile polvere, chiara cosa è che i suoi minimi ancor che per la lor piccolezza siano impercettibili a uno a uno dalla nostra vista, e dal tatto: tuttavia son’egli ancora quanti, figurati, e numerabili; […]. (pp. 40-41)

5.3. Conversational dominance (Ex. 3)

SALV. Havò qualche mio pensiero particolare, replicando prima quel che poco fa dissi, cioè, che l’infinito è per se solo da noi incomprensibile, come anco gl’indivisibili: or pensaste quel che saranno congiunti insieme; […]

SIMP. Quel nasce subito il dubbio, che mi pare insulabile; & è che sendo noi sicuri trovarsi linee una maggior dell’altra, tutta volta che amendue contegghino punti infiniti bisogna confessare trovarsi nel medesimo genere una cosa maggiore dell’infinito, perché la infinità de i punti della linea maggiore eccederà l’infinità de i punti della minore. Ora questo darsi un infinito maggior dell’infinito mi par concetto da non poter’esser capito in verun modo.