Authorial Identity Constructed in Popular-Science Texts: Exemplified by Stephen Hawking's Two Texts on Black Holes

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1 Introduction

Increasingly more scientists have taken an active participation in communication of scientific and technological progress to the general public, among whom are the prominent figures such as Nobel laureate Roger Penrose and also the late Stephen Hawking. These renowned scientists could "convey the authentic experience" (Hawking, 2001: 209) to the lay reader outside the specific professional field. Popular science works have an enormous bearing upon the general public's understanding of scientific development and knowledge produced by academic research, but they could never be simplified as infotainment (Hyland, 2010: 118). A scientist-author is able to make evaluation and comments on the discourse and real-world identities and furthermore, influence the readers' understanding of the world (Hyland, 2005: 8). Popularized science is different from while closely related to academic science *de facto*, and when shifting to a different target reader group, a scientist makes Ideational transformation of the concepts and theories (Hyland, 2010; Lei, 2020).

IDENTITY is socially constructed through the mediating mechanism of discourse by producing and receiving representation of reality (Ivanič, 1998: 17). It is of significance to delve into this concept within the social context, including both the author-reader interaction as well as the norms of the operating culture (Ivanič, 1998: 77). Therefore, closely related to identity construction is the concept of DISLCOURSE COMMUNITY (Brodkey, 1987; Bizzell, 1989; Cooper, 1989; Freed & Broadhead, 1987; Nystrand, 1990; Swales, 1990).

The issue of identity in the science discourse has drawn a lot of linguistic attention for quite a long time (e.g. Bazerman, 1988; Berkenkotter & Huckin, 1995; Myers, 1990). In academic writing as a special type of discourse, scientists engage in a conversation with the readers and construct their authorial identity instead of objectively reporting research (Hyland, 2004). In contrast, linguists have paid insufficient attention to the identity of a scientist-author constructed in the popular-science discourse as a similarly important and also relevant language variant. To call for more attention to the important role played by scientists in the whole

science communication, this paper aims to conduct a functional stylistic analysis of a science text and a popular-science text both written by Hawking the famous scientist and popular science writer on the same theme of black holes. This paper consists of six sections. Section 2 briefly reviews the literature regarding the Interpersonal metafunction of Systemic Functional Linguistics and linguistic studies on popular science; Section 3 introduces the data selection as well as the analytical procedure; Section 4 presents a detailed description of the two texts, followed by the interpretation in Section 5 discussing the newly proposed bipartite authorial identity and the power-solidarity balance in the popular-science discourse; Section 6 is the final conclusion.

2 Literature review

This section first reviews the Interpersonal metafunction within Systemic Functional Linguistics together with the Appraisal system proposed by Martin and White as well as authorial interference borrowed from narratology, and briefed in the second sub-section is literature on popular science from different metafunctional perspectives.

2.1 Interpersonal metafunction of Systemic Functional Linguistics

Within the Systemic Functional Linguistics, language as a meaning-making system realizes three essential metafunctions, among which INTERPERSONAL metafunction enacts personal and social relationships and correspondingly construes the meaning embodied in the structure of a clause as exchange (Halliday & Matthiessen, 2014: 30-1). Within the concept of REGISTER proposed by Martin (1992), its three constitutive social-context categories FIELD, TENOR, and MODE respectively correspond to the three metafunctions. Closely related to the Interpersonal mode of meaning, tenor is concerned with the relationship constructed during the communication process and also the speech roles taken by the participants, which could be divided into the four fundamental types of offer, command, statement, and question (Halliday, 1974: 95; 1985: 9-12; 2014: 135).

The framework of APPRAISAL was first proposed by Martin and White (2015) as a further extension of the Interpersonal metafunction (Halliday & Matthiessen, 2014; Martin, 1992; Martin et al., 2010; Matthiessen, 1995) and also the appraisal analysis conducted by Eggins and Slade (1997) on spoken language. The framework is concerned with the construction of authorial identity through the linguistic mechanism for emotional, attitudinal and evaluative sharing, as well as (dis)alignment

between communication participants and construction of an intended reader (Fuller, 1998; Martin & White, 2015; White, 2000, 2003). Appraisal as a discourse semantic resource consists of three sub-domains: ATTITUDE concerned with emotional feelings, judgment and evaluation, ENGAGEMENT attending to how the writer's value position is advanced, and GRADUATION focusing on the gradability of the evaluative resources (Martin & White, 2015: 35-7; Peter, 2003). This theory has been widely applied to analyzing various types of discourse, including educational discourse (Christie & Martin, 1997; Macken-Horarik & Isaac, 2014), forensic discourse (Wang & Wu, 2020), ecological discourse (He & Ma, 2020), journalistic discourse (White, 2009), political discourse (Li & Liu, 2020) and also literary discourse (Hadidi & Mohammadbagheri-Parvin, 2015). Wang and Wu (2020) discussed the complementarities of the Appraisal system and metadiscourse, emphasizing the macro perspective of the former on the whole discourse and the demonstrations (both explicit and implicit) of interpersonal meaning by the latter.

But what has been ignored in previous studies is that the narrative uniqueness of a popular-science discourse as the shape of knowledge could greatly influence the readers' apprehension (Fisher, 1987: 193). Therefore, it is necessary to justify the introduction of the narrative term AUTHORIAL INTERFERENCE to this comparative study of two non-literary discourses. As is emphasized by Chatman (1978: 27-8), the two essential components of a narrative text are STORY, semiotically representing the content, and DISCOURSE, the expression; and in this way, a narrative as a communication could be actualized by different types of media, such as language, music, painting. Therefore, a popular-science discourse is undoubtedly a typical narrative with the scientist taking the role of narrator, which could be further divided into covert narrator and overt narrator subject to the extent of narratorial mediation (Prince, 1987: 68). Authorial interference could be regarded as an intrusion by an OVERT NARRATOR in the form of comments upon the situations and events presented or the context, and in this way the author's responsibility is opposed to that of the narrator (Chatman, 1978: 228; Genette, 1980; Prince, 1987: 9, 14, 46).

2.2 Linguistic studies on popular science

Little attention has been paid to popular-science discourse in terms of the semantic resources of evaluation, given that this language variant has been ignored compared with long-term studies on the language of science from various perspectives (see Halliday, 1988/2004, 1994, 1998, 2006; Halliday & Butt, 2019;

Martin, 1993a, 1993b). Previous literature has been more concerned with the Ideational (see Crismore & Farnsworth, 1990; de Oliveira & Pagano, 2006; Fuller, 1998; Pilkington, 2018a, 2018b; Yang, 2011) and Textual features (see Curtis, 2004; Mellor, 2007; Myers, 1990a, 1990b, 1991, 2003) prominent in popular-science discourses. Among the studies on the Interpersonal level, Halliday and Martin (2003) emphasized the concept of recontextualization and the ideal reader group underpinning the popular-science discourse; Deng (2009) focused on the author-reader relation constructed by the two systems of engagement and negotiation, as well as on the Mood system. Additionally, Myers (1989) and Hyland (2010) conducted comparative analyses of science and popular-science discourses in terms of the Interpersonal metafunction: The former was concerned with the politeness in the two types of discourses while the latter conducted a larger-scale analysis to demonstrate the difference in the author's proximity to two groups of target readers.

However, a scientist's authorial identity constructed in his communication with the general public has not been touched upon within a comprehensive framework integrating various Interpersonal resources. If we fail to recognize the significance of discoursal identity, the uniqueness of science popularization in terms of role enacting and value sharing through negotiation of social relations (Hood, 2019: 383) cannot be fully demonstrated, thereby impossibly affording a reasonable explanation of the essential Ideational and Textual transformation from science to popular science underpinning the commonsensical difference in the putative reader. Therefore, this research aims to delve into the foregrounded authorial identity which enables the scientist's effective communication of scientific knowledge as well as his value and belief to the lay reader in the popular-science discourse as an interaction.

3 Data and method

This section introduces the corpus selection and also the analytical procedure designed for the following description and interpretation.

3.1 Corpus selection

The corpus to be analyzed in this research consists of two discourses both authored by Hawking on the theme of black hole formation. Hawking, as one of the greatest scientists and popular-science writer, owns many works to his credit. The science portion is excerpted from Hawking's article "The event horizon" collected in *Black holes* (1973: 5-6). This article was particularly considered by Hawking himself

as a description of most of his work on classical black holes and "the culmination of the Golden Age" (1993: 2). The science discourse included in this corpus consists of 28 segments of 588 words in the section of Introduction part of the article.

The corresponding popular-science portion, excerpted from the second chapter of "The shape of time" of Hawking's representative popular-science work *The universe in a nutshell* (2001), includes 24 segments of 562 words (Hawking, 2001: 38-41). The reason why this work is chosen instead of the earlier and better known *A brief history of time* (1989) is the noticeable improvement and update of both language and scientific achievement. Hawking (2001: vii) admitted that this work shows much difference from the previous huge success, as he realized the importance of explanation in a language "much easier to understand" and the textual configuration should be adjusted to attract the readers' continuous interest. In addition, this work has been recommended by both Hawking himself and other scientists in the community of popular-science writing.

Both discourses are concerned with light getting deflected by the gravitation after emission and finally becoming converged. Hawking the scientist's attitude around the Ideational explanation is expressed in different ways when he addresses different target readers, which is of remarkable Interpersonal importance. Besides the corresponding extracts, 8 examples of total 332 words also about the concept of black holes, are added to the whole corpus for the analysis of authorial interference as a foregrounded Interpersonal feature in the popular-science discourse.

3.2 Analytical procedure

Such a carefully selected small-scale corpus is representative enough for the comprehensive analysis of the authorial identity construction. Discourse analysis of the authorially and thematically identical science and popular-science discourses is conducted in a theoretical framework integrating the Mood system, the Appraisal system and authorial interference, as illustrated in Figure 1. The Appraisal system together with its subordinated sub-systems and components are displayed in Figure 2.
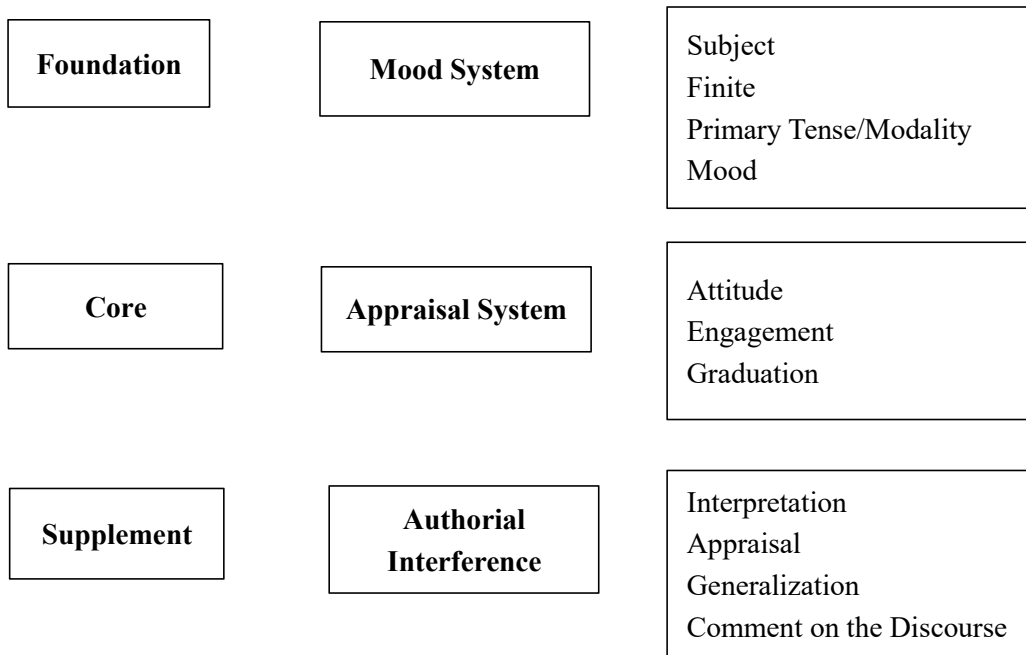
Foundation	Mood System	Subject Finite Primary Tense/Modality Mood
Core	Appraisal System	Attitude Engagement Graduation
Supplement	Authorial Interference	Interpretation Appraisal Generalization Comment on the Discourse

Figure 1: Integrated Theoretical Framework

This integrated theoretical framework is applied with the following two steps:

1. The science discourse and the popular-science discourse are both annotated within the Mood system and the Appraisal system. Then the respective foregrounded features are summarized according to the description and the frequency count.

2. The 8 examples of authorial interference are annotated and categorized following the appraisal analysis. What should be noted is that the specific context information is also supplemented for a better understanding of the articulations.
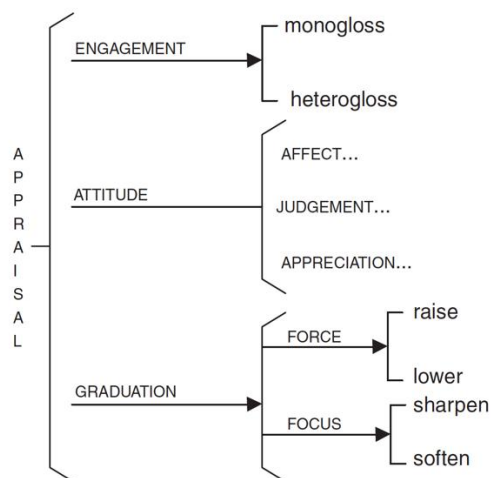

Figure 2: Overview of the Appraisal system (Martin & White, 2005: 38)

Against the science discourse as the background, the Interpersonal features foregrounded in the popular-science discourse as a unique register could be more comprehensively interpreted in terms of tenor of discourse. Such a small-scale study will be sufficiently generalizable to comprehension of popular-science writing created by other scientists transformed from science writing on the same theme and thereby reach a larger radiation scope.

4 Discourse description

This section displays the detailed annotation and description of the two discourses in terms of the Mood system and the Appraisal system together with the examples of authorial interference foregrounded in the popular-science portion.

For the sake of convenience and consistency, all clauses follow the same numbering rule: Extracts from the scientific article start with S and clauses from the popular-science portion of the corpus start with PS. Particularly in the first sub-section of the Mood system, an additional numbering rule is borrowed from Halliday's (1992) analysis, which uses capital letters A, B, C to indicate the constituent clauses within a clause complex.

4.1 Mood system

Annotations in the Mood systems cover selections of Subject, the Finite elements (the Finite operator, tense, polarity, and voice) and the mood of clause in the two types of discourse. The annotations of these interrelated discourses in terms of the Mood system are respectively summarized as follows:

The science discourse could be divided into two parts, which have different **primary tenses**: Around the core concept of EVENT HORIZON, the tense shifts from **future** preponderant in the first eleven segments to **present** in the following seventeen segments. Another foregrounded feature is the inanimate **Subject**. 34 ranking clauses, an overwhelming majority of the science discourse, have the abstract concepts as Subjects, e.g. *light*, *wavefront*, and *divergence.*

In stark contrast, 37 out of the 43 ranking clauses in the whole popular-science discourse have **present** as the consistent **primary tense**, and the first-person speech role *we* functions as the Subjects of 9 clauses together with the possessive determiner *our* modifying 5 Subjects (except *our* in PS23A which obviously refers to Penrose and Hawking). The same personal pronoun *we* in the science discourse has a confined

reference to the author and members involved in the scientific research, while the readers are also included by the speech role in the popular-science discourse so as to build a broader community together with the scientist.

4.2 Appraisal system

Beyond modality as a highly grammaticized system is the comparative analysis within the Appraisal system, including both modality expressing certainty and non-modal evaluation formulations as judgments of good or bad (Aijmer, 2019: 502, 513).

The comparison of the science discourse and the popular-science discourse in respect to the distribution of three sub-systems under the Appraisal system is shown in Figure 3. As for the sub-system of attitude, there are more affect expressions in the popular-science discourse than in the science discourse, with the author's positive or negative feelings prominently realized in the expressions. Within the semantic region of engagement, dialogic contract is more prominent in the popular-science discourse than in the science discourse. The two discourses display even more obvious difference in graduation, with much more instances of force occurring in the science discourse.
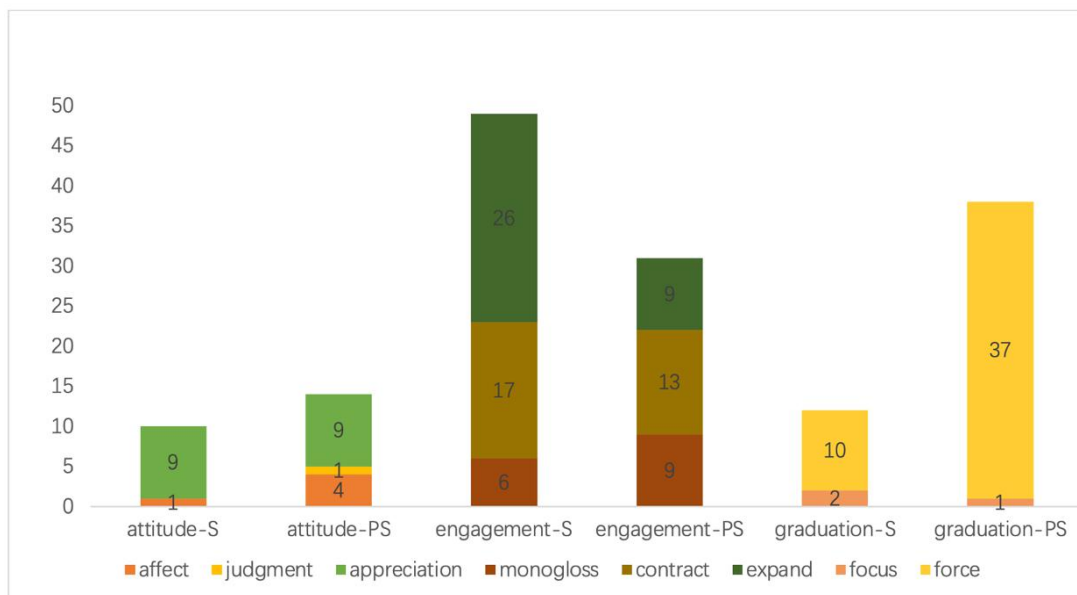

Figure 3:   Comparison of distributions of the Appraisal system in the science and popular-science discourses

4.2.1 Attitude

Table 1 is a comparison of the science discourse and the popular-science discourse in respect to the attitude sub-system. The author inclines to express evaluations rather than emotional feelings, with 'valuation' of things as the most preponderant variable (7 instances), so as to realize the impersonal and objective enunciation. In stark contrast, more resources of affect (4 realizations) and appreciation related to 'reaction' to things (also 4 realizations) are regularly applied by the scientist in the popular-science discourse. It is noteworthy that the author's affective feelings are all realized as processes, appearing in the narration of the background information at the beginning or the end of the whole discourse.

Table 1: Comparison of distributions of the attitude sub-system in the science and popular-science discourses

		Science	Popular Science
affect	security		1
	satisfaction	1	3
judgment	normality		1
appreciation	valuation	7	4
	composition	2	3
	reaction		2
total		10	14

Appreciation, though occurring regularly in both discourses, has been applied by the scientist to register different evaluations of things. Four among the six appreciation expressions in the science discourse belong to the sub-type of 'valuation', which could be interpreted from the metafunctional perspective as "oriented to ideational significance" (Martin & White, 2005: 57) and used by the author to emphasize the significance of the concepts or phenomena. 'Reaction', without any realization in the science discourse, has the most prominent occurrence in the popular-science discourse which metafunctionally possesses the "interpersonal worth" (Martin & White, 2005: 57). Such a noticeable divergence could be partially demonstrated as follows:

S21. The behavior of the ingoing null geodesics is <u>of importance</u> [*+ve valuation*] in proving the occurrence of a spacetime singularity in the trapped region. (Hawking, 1973: 6)

The 'valuation' realization in this scientific expression answers the question of "was it worthwhile", closely related to the Ideational significance of the mentioned behavior. Construed through this evaluation is, instead of the author's emotional feeling, the scientist's cognition of the close relation between the two processes.

PS12. This microwave radiation is not much <u>good</u> [*+ve reaction*] for defrosting frozen pizza, but the fact that the spectrum agrees so exactly with that of radiation from a body at 2.7 degrees tells us that the radiation must have come from regions that are opaque to microwaves. (Hawking, 2001: 39)

The evaluative meaning *much good* included in this example belongs to the 'reaction' variable which construes the author's emotion or affect oriented to Interpersonal value. By answering the question of "did I like it", this appreciation conveys to the lay readers the author's attitude towards the core concept *microwave radiation*. Without other numerical or objective information provided, this realization is enough for the putative reader to roughly construe the role of the radiation.

4.2.2 Engagement

The engagement system is concerned with the author's "alignment/disalignment vis-à-vis various value positions" (Martin & White, 2005: 95). The science discourse tends to invite the sharing of different opinions and voices, while the popular-science discourse explicitly tries to direct readers into a community of aligned value and belief (as is shown in Table 2).

It could be clearly observed that in the science discourse, heteroglossic expansion "allowing for alternative voices" (Martin & White, 2005: 103) with 26 realizations are more prominent than monogloss (6 instances) and heteroglossic contraction (17 instances) which deny or restrict alternative positions; in stark contrast, the same scientist adopts more monoglossic and dialogically contractive realizations (respectively 9 and 13) in the popular-science discourse, compared with the 9 dialogical expansions. The following two examples could further demonstrate the difference.

Table 2: Comparison of distributions of the engagement sub-system in the science and popular-science discourses

		Science	Popular Science
monogloss		6	9
heterogloss: contract	pronounce	2	2
	endorse	2	4
	deny	9	5
	counter	4	2
heterogloss: expand	attribute	2	1
	entertain	24	8
total		49	31

S2. One <u>would</u> [*expand: entertain*] therefore imagine that if there were sufficient amount of matter in a certain region of space, it <u>would</u> [*expand: entertain*] produce such a strong gravitational field that light from that region <u>would</u> [*expand: entertain*] not be able to escape to infinity but <u>would</u> [*expand: entertain*] be "dragged back". (Hawking, 1973: 5)

Among the total of 22 modal auxiliaries in the science discourse, those with weaker probability or usuality, or the so-called hedges, are more frequent such as *will* (8 times) and *would* (5 times). However, four occurrences of *would* here in S2 don't literally represent a lower degree of probability, but instead show "deference, modesty and respect" to the whole scientific community (Hyland, 2000: 88). As a scientific fact is collectively stabilized from criticism and confirmation (Latour, 1987: 42), what is conveyed via such hedges in the science discourse is not lower probability of the propositions nor the author's uncertainty, but "offering a claim to the community" appropriately (Myers, 1989: 13). The members of the scientific community keep a great distance with each other, with a huge power disparity displayed between an individual scientist and the whole community (Myers, 1989: 28).

PS12. …but the fact that the spectrum agrees so exactly with that of radiation from a body at 2.7 degrees <u>tells</u> [*contract: endorse*] us that the radiation must have come from regions that are opaque to microwaves. (Hawking, 2001: 39)

As the author no longer has to win the acceptance of the professional community in the popular-science discourse, monogloss and dialogical contraction with more

certainty are preponderant displaying stronger subjectivity as well as less accuracy. In PS12 is the sub-category of 'endorsement', which could guarantee the warrantability of the authorial voice (Martin & White, 2005: 126). Taking the prominent speech role *us* into consideration, the author could thereby persuade the lay readers to believe the strong causality between the fact and the source of the radiation.

The author stands in a less powerful position faced with the whole scientific community, and therefore modal auxiliaries of lower probability mark his attempt to attest the rigor of reasoning and win the acknowledgment of the whole community. With the support of monogloss and dialogic contraction, the author who represents authority is able to invite the laymen public to his own value position with strengthened rapport, conveying the message that his opinion is agreed upon by other members of the scientific community or even the only voice to be accepted.

4.2.3 Graduation

Shown in Table 3 is the difference in the graduation sub-system. While the type of focus is not regularly applied in both discourses, force graduation including 20 realizations assessing degree of intensity and 17 measurements of amount and extent (Martin & White, 2005: 148), is much more prominent in the popular-science discourse vis-à-vis the science counterpart. The following two examples explicitly demonstrate the bifurcation.

Table 3: Comparison of distributions of the graduation sub-system in the science and popular-science discourses

		Science	Popular Science
focus		2	1
force	quantification	2	17
	intensification	8	20
total		12	38

S7. At first this wavefront will be <u>nearly</u> [*intensify: up-scaled quality*] spherical and its area will be proportional to the square of the time since the flash was emitted. (Hawking, 1973: 5)

In S7, the author continues his reasoning of the wavefront development in S5 and S6. By the modal auxiliary *will* of median probability, the author indicates that his own explanation may not be the only reasonable one and perhaps challenged by other

alternative opinions. The dialogically expansive backdrop in the process is further intensified by the adverb *nearly* as the pre-modifier of the quality *spherical*, so as to avoid the professional members' challenge of the measuring criteria, thereby making the description of the *wavefront* more precise and objective.

PS17. As one follows our past light cone back <u>still further</u> [*intensify: comparative*], the positive energy density of matter causes the light rays to bend toward each other <u>more strongly</u> [*intensify: comparative*]. (Hawking, 2001: 41)

'Comparative' is a prominent intensification applied in the popular-science discourse with 9 realizations. By the comparatives *still further* pre-modifying the process of following the light cone and *more strongly* as the pre-modifier of bending light rays, the author is able to explicitly display the logic relation between travelling back and light deflection.

As is shown in the previous comparative analysis, the graduation system further complement the other two systems of attitude and engagement: the heteroglossic and contentious backdrop in the science discourse is further intensified so as to emphasize the author's objectivity and preciseness in face of the putative professional readers, while imprecise reckoning and reasoning in the popular-science discourse enables the author's explanation construed by the lay readers as authoritatively trustworthy.

4.3   Authorial interference

The attitudinal or commentary utterances which may not contribute to the progress of reasoning and explanation also play a substantially significant role in the construction of the author-reader interaction.

Among the four categories of INTERPRETATION, JUDGMENT, GENERALIZATION and COMMENT ON THE DISCOURSE defined as authorial interference, judgment (will be thereafter replaced by narrator's appraisal given that judgment is already named as a sub-system under the appraisal system) is concerned with the narrator's moral, value and belief positions; comment on the discourse is related to the narrator's comments which doesn't undercut the fabric of the fiction (Chatman, 1978: 228, 248). The 8 examples of authorial interference annotated and analyzed in this research are all located before or following the conceptual explanations originating from the science counterpart and complements the Interpersonal features discussed in the previous sections. They are classified into the two categories of narrator's appraisal (PS26, PS27, PS 28, PS29, PS 31, PS 32) and comment on the discourse (PS 25, PS 27, PS 29).

PS25. (Issac Newton gave us the first mathematical model for time and space in his Principia Mathematica, published in 1687.) Newton occupied the Lucasian chair at Cambridge that I now hold, though it wasn't electrically operated in his time. (Hawking, 2001: 32)

The historical background of Newton's honorable title follows the introduction of the mathematical model proposed by Newton in 1687. Then the author continues to make a comment on the discourse, sharing with the reader his own connection with this honor while *chair* as a polyseme represents both the university title and the wheelchair the scientist uses. This articulation could be regarded as the scientist's intervention through "commentarial excursus" (Prince, 2003: 9). Though the continuity of the narration is broken to some extent, such authorial interference further highlights the professional reputation of the scientist-narrator while substantially contributing to his alignment with the lay readers.

PS26. It has been a success story [+*ve appreciation*] of the work of a large number of people, and I'm proud [+*ve affect*] to have made a small [*quantify: mass*] contribution. (Hawking, 2001: 34)

Here in this clause the author makes a straightforward appraisal of his own academic work and also expresses his emotion. Different from the attitudes analyzed in the previous sub-section, this appraisal is made by the scientist as the overt narrator making no substantial contribution to the whole progress of introduction, compared with the scientist as a participant in *Roger Penrose and I adopted a different approach* in PS2.

5 Discussion: Authorial identity construction

The comparative analysis in the foregoing section demonstrates the prominent differences between the two discourses within the Interpersonal metafunction. In the science discourse, the past-to-present primary tense shift complemented by the dominant inanimate Subject within the Mood system is coterminous with valuations of things realized through dialogic expansion within the Appraisal system. However, in the popular-science discourse, present as the consistent primary tense accompanied by the speech role *we* as the dominant Subject is foregrounded in the Mood system while the scientist's emotional feelings and reactions are registered through the mechanism of dialogic contraction and further strengthened by the imprecise reckoning and graduation. In other words, the scientist is "negotiating information" in the science discourse and "giving information" in the corresponding popular-science

discourse (Halliday & Martin, 1993: 38). Noteworthily, regarding the popular-science discourse as a narrative with the scientist also functioning as an overt narrator, this study innovatively adopts authorial interference from narratology in discussing the evaluative resources unable to fit the categorization within the Appraisal system.

It is necessary to interpret the foregoing features in the two discourses as two different but interrelated contexts so as to probe in their specific Interpersonal significance. In the following two sub-sections, the author's dual voices as well as the germane power-solidarity balance will be successively propounded for the further discussion of how the unique authorial identity constructed in the popular-science discourse reacts upon the Ideational transformation from the interrelated science discourse.

5.1   Participant and narrator voices

Different configurations of evaluative meanings in the two different types of discourse could to some extent help summarize the respective patterns of evaluative keys in science and popular science. Coffin (2002) in her research on the evaluative values in the key of history, made a relevant voice taxonomy of RECORDER VOICE, INTERPRETER VOICE and ADJUDICATOR VOICE, which belong to different keys of appraisal and judgment. Later Martin and White (2005) termed three evaluative keys in journalistic discourse as REPORTER VOICE, CORRESPONDENT VOICE, and COMMENTATOR VOICE, among which unmediated inscribed judgment and appreciation as well as authorial affect are curtailed or constrained in both reporter and correspondent voices while occurring regularly in the commentator voice.

However, neither classification could be directly borrowed for differentiating Hawking's voices in the popular-science discourse. If a simple division is made according to whether any evaluation is made or not, the unique examples of authorial interference have to be mixed with the formulations of affect without any further distinction. Therefore, it is necessary to revise the existing classifications with the science counterpart as the backdrop.

Compared with the one and only role as a participant negotiating information with the whole professional community in the science discourse, the same scientist plays dual roles foregrounded in the popular-science discourse respectively corresponding to two different voices: When the scientist functions as the participant in the scientific exploration, similar to that in the science discourse, he introduces the core concepts together with evaluation of their importance, which collectively

contribute to the whole enunciation; as an omnipresent narrator out of the enunciation, the scientist makes both evaluative formulations and value-free comments connecting the relevant figures and events with himself. This is the essentially unique feature differentiating the voice classification newly proposed in this research from the previous methods: No matter in the history discourse (Coffin, 2002) or the journalistic discourse (Martin & White, 2005), an author describes and evaluates the events as a narrator without participating or getting involved in the actual process; in stark contrast, the unique role played by the scientist as the participant in the scientific discovery or exploration is the basis upon which the lay reader construes his authoritative reputation.

Therefore, a pair of terms PARTICIPANT VOICE and NARRATOR VOICE are newly proposed here in the discussion of authorial identity constructions in the science discourse and the popular-science counterpart. The participant voice is activated when the scientist is involved in the specific scientific progress, thereby prevailing in both the science and popular-science discourses. However, when shifting to the role of an omnipresent narrator exclusive in the popular-science discourse, the scientist's voice, instead of promoting the unfolding of the theoretical explanation, shares the scientist's own stories or introduce relevant background knowledge. In addition, the scientist makes his presence felt through the flexible configuration of authorial appraisal, thereby overtly demonstrating the authorial value and position. In this way, when the scientist turns to the putative non-specialist reader, two coterminous voices contribute to the construction of a bipartite authorial identity. Said another way, the scientist doesn't address exactly the same thing to different target reader groups in this transformation process, but explains ideationally different information while shifting to different roles. Closely related to such a different authorial identity is the unique power-solidarity balance, which will be discussed in the following sub-section.

5.2 Power-and-solidarity balance

As two key tenor variables in building the Interpersonal relations, POWER is concerned with the dominant and deferential positions between interlocutors, while SOLIDARITY provides semiotic resources for the negotiating intimacy and distance (Martin & White, 2005: 29-31). According to the foregoing analysis, the power imparity is explicitly reversed when the scientist addresses different putative readers. Instead of standing in an inferior position in persuading the professionals, the scientist's authoritative power when faced with the lay reader is mainly construed

through the monoglossic expressions in the engagement system, intensification in the graduation system and also the omnipresence related to authorial interference. However, what is germane to the omniscient authority in the popular-science discourse is didacticism, which may discourage laymen readers from continuing to accept the scientist's introduction. Therefore, the opposition to power in the popular-science discourse is solidarity which enables the scientist to align the putative reader with his values and beliefs in a shortened distance.

Furthermore, such a unique authorial identity maintaining the power-solidarity balance also has an observable bearing upon the Ideational interrelation between the science and popular-science discourses. *Videlicet*, discrete concepts elucidated in the popular-science discourse breaks the chain of reasoning in the science counterpart (Lei, 2020: 58), leading to further transformation within the Interpersonal metafunction.

Figure 4 illustrates the unique bipartite authorial identity keeping a power-solidarity balance constructed in the popular-science discourse against the backdrop of the science counterpart. At the local level, Hawking as the participant integrates the introduction of discrete core concepts and interlocking definitions with his own evaluations. In this way, all these concepts are configured with different degrees of prominence shaped by the scientist's own preference. At the macro level, Hawking functions as the omnipresent narrator of the whole scientific process and is free of the temporal and spatial limitations. Different from the role of participant, the narrator makes no contribution to the detailed explanation of the core concepts but provides necessary historical background information usually arranged in the vicinity of the theoretical explanation. In this way, the power-solidarity balance inherent to the scientist's dual-role identity is realized on the micro and macro levels of the popular-science discourse as an integrated semantic system of evaluation. Such a power-solidarity combination is obviously a great challenge. If the scientific authority exceeds the intimacy, the layman reader may be discouraged by the overwhelming didacticism; if the rapport is excessively emphasized, the readers' trust and respect might be lost. Therefore, such a balance underpinning the scientist's dual-role authorial identity is the foregrounded Interpersonal feature which contributes to the meaning and knowledge creation in the popular-science discourse transformed from the science counterpart.
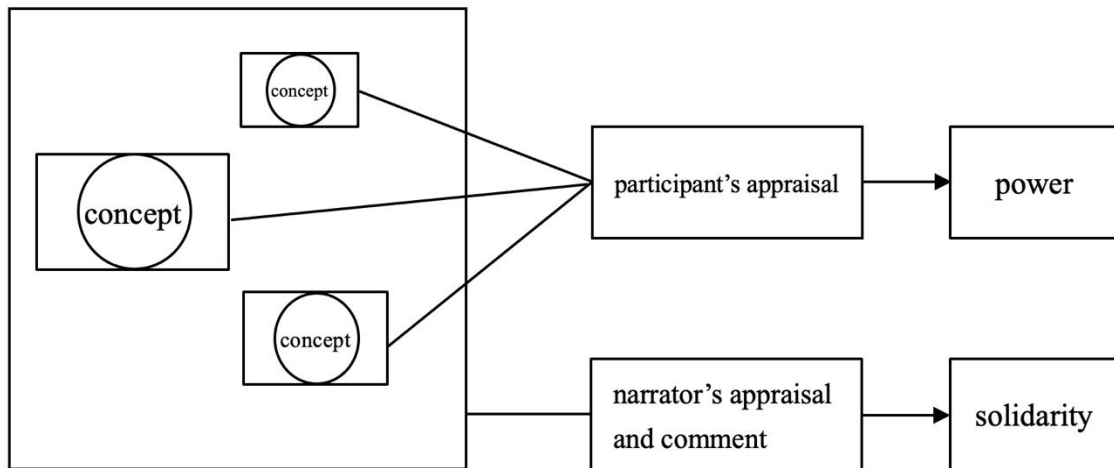
Figure 4:   Voices and power-solidarity balance

The theoretical significance of the authorial identity constructed in the popular-science discourse partially lies in the voice classification newly propounded by this research. Rather than following the widely accepted binary opposition between formulations with evaluation and value-free expressions, this research takes into consideration the unique interrelation between the science and popular-science discourses and divides the heterogeneous voices subject to different roles. In this way, the new voice classification highlights the uniqueness of the authorial identity which further contributes *de facto* to the essential transformation from the science discourse to the popular-science counterpart.

6 Conclusion

Scientists have suffered from the problematic public stereotype as mad or absent-minded professors for quite a long time (Kirby, 2011: 68). Though devoid of linguistic attention to popular science writing as a unique and important language variant for quite a long time, authorial identity plays a non-negligible role in a scientist's effective interaction with the general public. This research compares the Interpersonal resources respectively applied in the science and popular-science discourses both written by Hawking on the same theme of black holes, including the Mood system, the Appraisal system proposed by Martin and White, and authorial interference as a narrative feature.

Based on the detailed description and annotation, this study has reached a conclusion that Hawking's dual-role identity preserves the balance between the

professional reputation and the alignment with the lay readers, thereby effectively popularizing the scientific knowledge transformed from the interrelated science discourse.

Given the limitations of this study, some future prospects could also be suggested as an essential part of the conclusion. The small-size corpus will be further expanded to include more co-authorial and co-thematic popular-science and science texts written by influential scientists. Meanwhile, the intertextual relation provides a novel perspective on the interrelation between science and popular-science discourses within the Textual metafunction. In this way, more linguistic attention will be drawn to science popularization.

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