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Science diplomacy from a nation-state's perspective: a general framing and its application to Global South countries

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Abstract

Based on International Relations (IRs) grounding theories, this article outlines a realist-constructivist perspective in science diplomacy when assessing a nation-state's foreign policy decision-making and behaviour. The proposed theoretical framing helps us evaluate existing practices of science diplomacy within the larger context of IRs and allows us to better understand the increasing role of science diplomacy and its potency in the foreign policy of emerging and developing countries. The proposed exploratory research methodology outlines the contours of a science diplomacy reading grid breaking it down into the categories of objectives, strategic drivers, and tools. The data collection and semi-structured interviews with high-ranking practitioners and experts allowed us to assess the meaning of science diplomacy as understood and implemented by Global South countries and to distinguish science diplomacy practices as oriented towards the satisfaction of domestic needs and international positioning.

Key words: science diplomacy; foreign policy; international relations; Global South.

1. Introduction

Rapid economic and political changes in emerging and developing countries have an impact on the existing world order that is gradually moving from a Western-centred international system to a multi-centred one. Some lesser powers that were previously on the periphery of international politics now seek to gaining more power and building international reputation using various tools including diplomatic ones that were unavailable or inapplicable before. The shift in power politics and the change of the world order cannot happen immediately and it is unnecessarily destined that way because traditional great powers keep their leadership strong. However, acknowledging the rise of emerging and developing countries of the Global South and their ability to shape or, at least, to influence the world order is critical to better understand the ongoing changes and to help decision-makers navigate world politics where science diplomacy practices increasingly spread out.

We start with a simple question: 'Why a country might invest resources in science diplomacy?' (Gluckman et al. 2018). To answer this question from a nation-state's perspective, we need to specify what are the objectives of science diplomacy, which inspires nowadays the policies and practices of a growing number of countries in the Global South. It emerges from a review of the literature that science diplomacy can be conceptualised as the set of practices at the intersection of science and foreign policy and which logic is twofold: advancing national interests and needs and addressing global challenges (Krasnyak and Ruffini 2020). Starting from this perspective, we use an exploratory *methodological approach* that provides a framing of science diplomacy at two levels. We first situate the nation-state approach to science diplomacy in the theory of international relations (IRs). We then introduce a policy perspective and give particular importance to the strategic drivers that shape the nation-state approach to science diplomacy. For this purpose, we apply the empirical data collection gathered through semi-structured interviews and surveys, which enable exploratory research methodology to analyse the scope of responses of interview participants. Interviews with high-ranking science diplomacy government officials and experts from Brazil, Columbia, India, Pakistan, and South Africa help us identify the general strategy and the role that science diplomacy plays in the foreign policy aspiration of the countries these interviewees are from. Conducting and analysing semi-structured interviews enables us to directly observe and record notes refining ideas on what people think about science diplomacy and how they reflect on its assumptions and ideas in the questioning context. It also helps us provide an explanation of what predetermines science diplomacy implementations in foreign policy-making and behaviour. We considered the answers for the reliability and validity of the gathered empirical data. The use of the interviews and the questionnaire provides our main question, as stated earlier, with a satisfactory answer.

We suggest using a realist-constructivist *theoretical approach* for the general framing of science diplomacy. Acknowledging the primary existence of *materialistic* axioms and *ideational* distinctive themes, the conventional understanding of science diplomacy practices within this theoretical framework gives us a general sense of how things are supposed

to work and what the explanation should be. The realist-constructivist approach also helps us properly link empirical observations to a theoretical framework. Some scholars (Kaltofen and Acuto 2018) are sceptical about the idea to test IR theories on science diplomacy because of its historical, conceptual, and practical diversity and hybridity that are inseparable from epistemic practice and international politics. However, we believe like these authors that science diplomacy requires substantial theoretical engagement. Looking at international systems from fundamental theories of realism and constructivism in IR helps us to better understand how international systems operate because science diplomacy does not exist in a vacuum but is embodied in nation-states' foreign policy-making and behaviour. Focusing on realism and constructivism exclusively, we intentionally do not examine liberalism in IR and the ideas of liberal hegemony because the debates about liberalism and the interpretation of liberal values might contradict practices of less democratic or authoritarian countries, which already have favourited or launched science diplomacy in external actions. Moreover, we take into account the growing debates on the disruption of the liberal hegemonic order in the post-Cold War world (Walt 2018; Mearsheimer 2019; Porter 2020), as well as the attempts and the possibilities raised by scholars to dissociate constructivism from the liberal tradition (Jackson 2004).

From these theoretical groundings, we look deeper at the science diplomacy phenomenon by distinguishing categories of *objectives, strategic drivers*, and *tools* starting from existing contributions in the scholarly literature. We further suggest an explanation of how these elements of science diplomacy shape a state's external actions thanks to specific resources, programmes, and ad hoc mechanisms. We recapitulate and discuss these categories with the aim of building a reading grid for a systematic analysis of a country's engagement in science diplomacy.

The article proceeds as follows. First, on the level of conceptualisation, we suggest that realism and constructivism merge in a creative relationship and might enrich IR theory and the understanding of science diplomacy by clarifying the relationship between the study of power in international politics and the study of IRs as a social construction (Barkin 2003). Then, on the level of operationalisation, we look at analytical categories of science diplomacy, define, and distinguish those categories into objectives, strategic drivers, and tools. Finally, we imply the empirical investigation and use distinguished analytical categories assessing science diplomacy in a selection of countries of the Global South. The interviews with participants provide us with analytical insights into states' foreign policies by highlighting the science diplomacy phenomenon.

2. Framing science diplomacy in a realist-constructivist framework

The chosen theoretical framework requires explanation even though this approach might not be entirely new because the science diplomacy discourse is caught between idealist aspirations and realist necessities showing the vague understanding of using science as a diplomatic tool in international systems. From a realism's view, international systems tend to remain anarchic in the realm of recurring balances of power. From a constructivism's view, international systems tend towards imbalances and hierarchies based on certain ideas and perceptions of how the world system should work. The dichotomy between anarchy and hierarchy is controversial but the historical record offers evidence to support both ways (Nedal and Nexon 2019). The political authorities of different countries do not want centralisation but they have to coordinate their actions on the international scene in order to address global challenges, which lead to debates about utilising science diplomacy tools.

Acknowledging that 'for a country to make any investment that supports science diplomacy, the actions must be seen to either directly or indirectly advance its national interest' (Gluckman et al. 2018: 3), the reference to realism stands out as a starting point. We take realism as a fundamental theoretical approach with an emphasis on interests and power politics at the core of the international behaviour of states, although we do not distinguish between various types of realism. Acknowledging the fact that nation-states seek power, countries have developed their own national styles and science diplomacy practices that maximise their power and secure interests at best (Flink and Schreiterer 2010; Krasnyak 2018b). Mostly focusing on the primacy of material forces and capabilities, realism, however, does not deny moral aspirations of political actions and the normative dimension of IR making realism unnecessary in strict opposition to ideational constructivism. Constructivism, on the other hand, focuses on the social construction of international politics and projects what foreign policy should be out there. Applying a constructivist approach in science diplomacy helps us explain the ongoing willingness of nation-states to target specific aspects of global challenges such as environmental protection, climate actions, health and economic security, and pandemics. By giving a central stage to scientific advice in the decision-making and global governance of these challenges, science diplomacy affirms its constructivist inspiration.

The axioms of realism converge with the ideational motives of constructivism making the relationship between realism and constructivism feasible (Sterling-Folker 2002; Barkin 2003, 2010; Jackson 2004). We start from the basic axioms of realism, which are anarchy, state security, and national interests. The international system is anarchical at the core where self-regulating international world order emerges spontaneously following the balancing behaviour of states (Waltz 1979; Schweller 2016). An anarchic structure produces the balance of powers pushing nation-states to exercise power using a variety of approaches. Within an anarchical structure, various practices of diplomacy allow interaction among states. Diplomatic interaction tends to evolve into a hierarchy that depends on the projected power of each state classifying states as great or lesser powers. In this context, science diplomacy, which is shaped by major scientific and technological developments, is a power-projection mechanism. Anarchy is not unnatural to constructivists because under anarchy nation-states invent or create socially constructed norms and acceptable international behaviour which, in turn, allows the balance of powers in the multipolar world and promotes international cooperation.

The relationship between anarchy and security is central to realism viewing it as either a political obstacle or well manageable of situations (Deudney 2000). Both motives, however, are intertwined within materialistic axioms. The vulnerability of a state depends on various factors where the material

capabilities seem the most certain. The development of science and technology (S&T) that determines the selection of the strategic drivers of science diplomacy is a prerequisite for external influence. For instance, during the Cold War, the Soviet Union and the USA simultaneously used science diplomacy to compete and to foster international scientific cooperation (Krasnyak 2018a, 2020). That means that science diplomacy helped not only making states less vulnerable but also strengthening their security and promoting national interests. Following the same logic, the contemporary science and science policy aspirations of countries of the Global South are considered the basics for their science diplomacy practices.

In its 'addressing global challenges' dimension, science diplomacy presents itself as a virtuous approach and some collective foreign policy decisions such as environmental protection, and point to moral realism. For realism, morals are too subjective but a moral approach in foreign policy may promote stability among international political adversaries and serves political success (Stein Wrightson 1995). The realist framework shows some promise exhibiting that moral realism takes place in foreign policy behaviour with respect to corresponding attempts to gain a deeper understanding of the forces shaping national interests (Brostrom 2016). Moral realism tends to incorporate culture in international politics. This tendency leads the way towards constructivism, which develops the idea of the social and cultural constructs of international politics (Campbell 1992; Wendt 1999).

Being reflexive and focusing on ideas of social construction, the constructivist approach to IR is ideational in nature. Constructivism acknowledges material and social aspects that determine state interests and promote greater diplomatic investment and effort from multiple actors in public policy formation and implementation. Constructivism shapes international politics through persuasive ideas, collective values, culture, and social identities (Snyder 2004). An updated form of idealism, constructivism attempts to explain nation-states' foreign policy behaviour in social and cultural contexts. The constructivist belief is what the world *should be* rather than what it really *is*. Constructivism can offer advice to foreign policy decision-makers and communities on how a nation-state's behaviour should be *out there*.

Socially constructed norms, identities, and discourse are under the scrutiny of constructivist treatment. These ideational factors are circumstantial as they are commonly discussed in constructivist themes that are distinctive as they ought to explain the meaning of a nation-state's foreign policy behaviour and help project science diplomacy desirable outcomes.

Norms are based on identities and interests. Nation-states create norms that have common patterns and might similarly influence other countries' international behaviour, which emerges from domestic politics, international systems, or both. Norms differ depending on a state's socio-political characteristics and struggle to be universal because of the polarity of various domestic societies (Acharya 2004). Because science diplomacy is twofold in advancing state national interests and addressing global challenges, the phenomenon of science diplomacy could be taken as a universal norm for the international behaviour of states. When countries have to continuously adapt to the changing environment of the outside world, they search for those behavioural norms that help them adapt more effectively. A science diplomacy norm could be one of them.

Science diplomacy might also be related to the concept of identity in constructivism. Identity is derived from the social cognitive structure and relates to cognitive psychology. By searching for meaningful symbols and behavioural norms, identities help individuals understand the means of human existence, to project future concerns, and to define the outside world from domestic and international perspectives. In response to conditions in which states operate, people create national identities that not only strengthen international posture in regard to physical security but might reflect various dislocations and anxieties in people's consciousness defined as the condition of ontological insecurity (Tsygankov and Tsygankov 2021). Ontological security is no less important than physical security. Repeating attacks on ontological security might cause long-lasting damage to a state's reputation and identities, making a state to respond to ontological security threats whenever they emerge (Haugevik and Neumann 2021). People create state narratives on which national collective identities are built further extrapolating them to international identities. In Wendt's words, collective identities are important to the emergence of 'international states' because identities matter in the context of a state's physical and ontological securities, as well as for recognition and development (Wendt 1994: 385). For instance, science diplomacy is one of the approaches of the EU not only to create shared knowledge and identity but also to implement science diplomacy in EU foreign policy in areas of security, environment, health, space, and heritage (see, e.g. Degelsegger-Márquez et al. 2020-2021).

In a constructivist view, the collective social identity of a state has an impact on foreign policy behaviour and, what is more important, on the background of foreign policy decisions of *who*, *how*, and *why* to make these decisions. Understanding collective identities helps to better explain how nation-states project influence to the outside world, what is the motivation behind formulating foreign policy strategies, and how states behave in the real-world environment. It means that if a country sees itself as an advanced power in vaccine development, this country might use this advantage pushing unilateral negotiations to promote their vaccines to capitalise on new economic and geopolitical opportunities. Alternatively, using similar vaccine development, states might focus on generating soft power and improving their national image by donating vaccines and creating a narrative of a state as a responsible global power (Lee 2023). This ideational motive underlies a state's collective identity as a world leader, which is able to take responsibility and make a commitment to eradicating deadly diseases for common interests. States can do both ways simultaneously balancing between material and ideational motives. Either way, states use science diplomacy mechanisms enabling to develop creative equitable international cooperation and re-contouring the play of sovereignty, power, and security in IRs (Hotez and Narayan 2021; Elbe 2021).

The discourse in constructivism tightly corresponds with science diplomacy in the moral dimension of liberty and democracy, a set of moral precepts often associated with liberalism in IRs. However, we suggest that a state's moral

identity and its commitment to a moral course is closer to the spirit of constructivism rather than to that of liberalism because constructivism is idealist in nature and because it focuses on achieving common interests when cooperating with non-liberal countries.

International cooperation, one of the most important axioms of science diplomacy, should also be put within the realist-constructivist framing. Realism does not undermine the collective actions of states. In realism, cooperation emerges exogenously pursuing rational national interest forward. On the other side, constructivism explains that collective identity among states emerges endogenously at the systemic level and this process generates even more cooperation (Wendt 1994). Thus, cooperation in the intertwine of external and internal reasons deepens interaction between and among various actors, both state and non-state, making cooperation not only possible but sustainable. Considering the fact that actors in science diplomacy are driven by national interests and collective identities, the exogenous and endogenous motives of cooperation explain the phenomenon of science diplomacy from both perspectives.

In sum, the realist-constructivist framework is coming into play at a point where narratives of realism and ideas of constructivism allow us to deeper assess science diplomacy and to identify its analytical categories. We acknowledge science diplomacy categories as preexisting in the real world yet in the need to be discovered. Such a realist assumption merges with a constructivist idea of the real world contaminated with ideas, identities, and cultures. The realist-constructivist symbiosis enables science diplomacy categories of objectives, strategic drivers, and tools to be recognised and interpreted accordingly. In the following section, we outline those categories in order to further characterise science diplomacy national strategies.

3. Analytical categories of science diplomacy

We develop the analytical categories of science diplomacy, which include objectives, strategic drivers, and tools. We also identify the mix of strategic drivers, acknowledging that they may overlap, combine, and complement each other.

3.1 Objectives

Objectives assigned to science diplomacy may be seen as intermediary ones for reaching the ultimate and essential goals that any government aims at when engaging in IRs: the nation's survival and security, welfare, and prosperity. We leave this discourse aside as it corresponds with the realism discussed earlier. Likewise, in order to get straight to the point, we consider that the government has the will of defending and promoting national interests as a whole and not the interests of a particular group or social class.

The literature on international scientific cooperation provides useful leads for our purpose, with the distinction between its 'direct benefits' (higher quality of research) as opposed to its 'indirect benefits' (political, economic, and social) (Georghiou 1998), and with the distinction between 'intrinsic science oriented' objectives (Boekholt et al. 2009), which are 'directly aimed toward STI (science, technology and innovation) substantiation', and 'non-science policy objectives' or 'external ones, focusing on the support of other policies' (European Commission 2013: 11). Such classifications resonate with the distinction between the 'narrow cooperation paradigm' aiming at intrinsic objectives, and the 'broad cooperation paradigm' including non-science policy objectives (Boekholt et al. 2009; Fikkers and Horvat 2014). Originating from the study of international scientific cooperation, these categories can be extended to the field of science diplomacy, to which we recognise two main sets of objectives and expected benefits: *scientific* and *non-scientific*.

Scientific objectives relate to the research activity itself and to the resources that make it possible. They are of two types. First, advancing knowledge and problem-solving in basic and applied sciences. Countries may engage in science diplomacy with the aim of contributing to the increase of knowledge, whether for scientific discovery like space exploration and medical research or for the purpose of building evidence-based policies in order to address global challenges. The steps to reach both sets of goals are by nature those of international scientific collaboration. Second, enhancing S&T capacity, whether at the national level (strengthening the country's S&T ecosystem) or at the international level (building international *big science* infrastructures). At the national level, the goal is to raise the quality of national research and to elevate its position in the dynamics of global scientific production. The pursuit of scientific goals corresponds to the 'diplomacy for science' dimension of science diplomacy (Royal Society and American Association for the Advancement of Science 2010).

Non-scientific objectives relate to other policy ends than those of S&T policy. These objectives are not always explicit. They are subordinate to scientific objectives and their benefits are uncertain. We classify them into two broad categories: *political-diplomatic* and *economic and development* objectives.

Political-diplomatic objectives relate to conflict mitigation, solving global problems, building preferential regional partnerships, or security purposes. Science can inform and contribute to advance political-diplomatic goals, which was noted in the literature on international scientific cooperation (Skolnikoff 2001; Boekholt et al. 2009; Fikkers and Horvat 2014), and has been widely acknowledged by the literature on science diplomacy under the enlightening appellation of 'science for diplomacy' (Royal Society and American Association for the Advancement of Science 2010). A major argument of the dominant discourse is that international scientific cooperation can help maintaining or restoring dialogue in situations where political relations between countries are strained, thus offering alternative and complementary paths to 'pure' political diplomacy. Thanks to the values and practices of science, cooperation between researchers from different countries would therefore be able in certain contexts to improve the international order. Dialogue and joint work between researchers from different—and possibly hostile—countries may take precedence over the scientific content of cooperation: such diplomatic benefits give evidence of the political role of science diplomacy, which is a matter for discussion (Rungius and Flink 2020).

Tackling global societal challenges is central to the raison d'être of science diplomacy in its contemporary meaning. Threats on climate stability, biodiversity, or human health are challenges that no country can tackle alone, and scientific expertise is essential to feed international negotiations and to inform the collective action of states—the so-called 'science

in diplomacy' (Royal Society and American Association for the Advancement of Science 2010). From an ideational constructivist point of view to achieve a common good, science diplomacy is committed here to build consensus about global challenges and to contribute to the setting of appropriate international governance schemes.

Building preferential regional partnerships is another possible goal. Science diplomacy may aim at shaping international scientific exchanges through research programmes or academic mobility schemes in order to bring them into line with the geographic priorities of the country's external policy. Finally, science diplomacy may meet some goals of the national security and defence policy. Many of the threats to national security systems have a strong S&T dimension such as nuclear weapons, chemical and biological weapons, and cyber espionage. Related negotiation and implementation of international treaties require scientific expertise for advice and verification.

There are also *economic and development objectives* of science diplomacy. Economic objectives relate to trade and competitiveness in different ways. First, international scientific collaboration is a means to improve the country's competitiveness, provided it can elevate the quality of S&T inputs in national companies and improve their access to markets abroad (Boekholt et al. 2009). Second, scientific relations may help promote trade, as 'the boundary between international STI collaboration and Trade and Export support is very thin' (Boekholt et al. 2009). Third, science diplomacy may be part of international trade policies, due to the role of science in the setting of technical standards, and 'in resolving trade disputes particularly in areas related to food and agriculture' (Gluckman et al. 2018).

Development objectives of science diplomacy are observed in emerging and developing countries, for which enhancing S&T capabilities is of crucial importance. Their science diplomacy strategy is therefore marked by efforts to obtain resources for strengthening their S&T system.

3.2 Strategic drivers

By 'strategic drivers', we understand the intentions and principles that inspire and shape actions undertaken or supported by states in the name of science diplomacy. Strategic drivers are neither ends nor means by themselves, but guidelines that give meaning and structure to policies using various tools in view of reaching one or several goals. Strategic drivers have been understood in the literature on science diplomacy as 'goals' (Flink and Schreiterer 2010), 'motivations' (Van Langenhove 2017), or 'strategic purposes' (Rungius et al. 2018). We draw on and revisit the inspiring categorisation in terms of 'access', 'promotion', and 'influence' proposed by Flink and Schreiterer (2010). Our presentation differs as it considers 'cooperation' as one of the strategic drivers, it dissociates the access category into 'access' and 'attraction' (both relating to resource-seeking strategies), and it considers promotion as part of the 'influence' driver. We suggest that cooperation, attraction and access, and influence are the key strategic drivers of science diplomacy.

International scientific *cooperation* (or collaboration) is driven by the will of sharing goals and resources between partners of different countries. The commitment of governments to international scientific cooperation is repeatedly affirmed in official statements and is all the more easily acknowledged that it brings shared benefits. It translates into policies aiming at enhancing joint work between research performers across borders. In a broader view, it includes international scientific collaborations for solving global challenges. Efforts of countries to cooperate in the S&T area and to find common grounds in dealing with science-intensive transboundary challenges fall both under the generic heading of *collaborative* science diplomacy, which is the historical and dominant vision of science diplomacy.

A powerful inspiration of science diplomacy is the willingness to acquire property or the right to use international S&T resources. The two-directional dimension of this inspiration was identified as soon as 2009 in the literature on international scientific cooperation as the will 'to obtain *access* to state-of-the-art knowledge abroad as well as to *attract* state-of-the-art knowledge or people to the "home" country' (Boekholt et al. 2009: i—the emphasis is ours). Both dimensions reflect resource-seeking strategies. Attraction means bringing external scientific resources to the national territory within 'inward oriented strategies' (Boekholt et al. 2009: 14), and access means tapping into scientific resources located abroad within 'outward oriented strategies' (Georghiou 1998). Applying these categories to the analysis of science diplomacy, we advocate for having 'attraction' labelled as a strategic driver alongside 'access', given the key role played today by attractiveness policies in the competition for foreign talents. The scope of S&T resources that a country may want to access abroad is large: scientific data and results, emerging technologies, research infrastructures, human resources (especially those of the scientific diaspora), international networks, and financial resources, to name but a few. The scope of resources coveted through attraction is no less large: foreign scientific brainpower (researchers and doctoral students), international research infrastructure headquarters and premises, foreign direct investment in research and development, and financial resources.

Finally, there is *influence*. Generally speaking, influence is the ability to weigh in on decisions made by others. Influence is the capacity of an actor to induce opinions and behaviours of individuals or institutions, which align with the interests of the one who exercises it. In IRs, the emission of influence by states is a core dimension of diplomacy and translates into appropriate policies, of which public diplomacy is the archetype. In order to grasp what S&T-based influence as a strategic driver is, we must identify its two dimensions, relating to information and power.

Information theory, as it is used, for instance, in microeconomics, provides useful insight. In this context, information is defined as anything that leads to change the beliefs that people have. Technically, information is what changes the probability distributions that individuals attribute to the different states of the world (Hirshleifer 1973: 31). Disseminating information that leads to modify the representations, preferences, and behaviours in the interests of the information provider is a way of exerting influence. The promotion of national research institutions and scholarship programmes, the use of the country's scientific achievements for 'nation-branding' purposes, or lobbying activities are examples of a country's influence policy. Information is thus a source of 'power over others' (Nye 2011), alongside other manifestations of the power dimension of influence that fall under the highly publicised category of

soft power. Inequalities between countries in terms of S&T development are at the root of imbalances in their capacity to exert S&T-driven influence on the international scene.

We note that attraction, access, and influence drivers are directly linked to the competing interests of states and to the will to gain advantages over others. Contrary to the cooperation driver, they illustrate the competitive dimension of science diplomacy (Ruffini 2020).

3.3 Tools

The variety of tools through which a country engages in science diplomacy has been remarkably classified in the literature from a distinction between strategic, operational, and support tools (Van Langenhove 2017). *Strategic tools* are strategic documents issued by the government, especially by Foreign Ministries and Ministries of Science that give directions to what actors want to achieve and how to realise their policy goals. *Operational tools* are the policy instruments used to put science diplomacy into practice. They involve the specific resources—human and financial—dedicated by the government to science diplomacy and the mechanisms on how to use them, such as intergovernmental bilateral or multilateral S&T cooperation agreements, chief scientific advisers and advisory boards to the government, science attachés at embassies, or research funding schemes in support of international scientific collaborations. *Support tools* aim to promote science diplomacy through programmes for raising awareness, training, and building capacity for science diplomacy.

3.4 The strategy mix

The strategic drivers are not mutually exclusive, although they must be distinguished for analytical purposes. They may interact and operate simultaneously. They overlap, combine, and complement each other at the level of concrete initiatives and actions relating to science diplomacy. National strategies of science diplomacy are driven by a mix of cooperation, attraction/access, and influence motivations. Countries can be characterised by their 'strategy mix', that is, the weighting of each of these drivers in their overall science diplomacy strategy. Two fundamental factors shape their strategy mix. The first is the level of S&T development as measured by the importance of R&D expenditure in the gross domestic product (GDP), the number of scientific publications and international patents, and so on, which objectively predetermine a country's needs and capacities for action. The second is the desire to exercise—or not—power over others on a regional or global scale and to include the S&T dimension in this geopolitical approach. National strategies of science diplomacy must therefore be contextualised with regard to countries' scientific capabilities, needs, and foreign policy objectives. Idiosyncratic cultural and institutional features are also at play in shaping the mix of strategic drivers.

In order to assess a country's engagement in science diplomacy, we recommend to follow a two-stage exploratory methodological approach with the help of desk research and primary information from interviews of high-level policymakers and science diplomacy experts. The first step consists in establishing the factual basis of science diplomacy initiatives, resources, and tools that the country operates (its 'science diplomacy profile'). The second step consists in investigating the motivations that shape the country's engagement in science diplomacy, that is, the importance of each of the drivers in order to qualify the country's strategy mix. We believe that in principle, this methodology and analytical grid can be applied to the study of any country's science diplomacy. In the following section, we apply it to a set of Global South countries, with a particular focus on the second methodological step.

4. Objectives and strategic drivers of science diplomacy in the Global South: an empirical investigation

In this empirical part, we apply our theoretical and conceptual framework to the case of several countries of the Global South, which have officially claimed their commitment to science diplomacy. The selection of countries includes Brazil (BR), Colombia (CO), India (IN), Pakistan (PK), and the Republic of South Africa (ZA). The institutionalisation of their science diplomacy initiatives is the starting point for analysis. South Africa announced science diplomacy initiatives as soon as 2012 (Pandor 2012). Since 2017, Brazil stands out by promoting the concept of 'innovation diplomacy'. India first announced science diplomacy to be included in the National Science, Technology, and Innovation Policy in 2018. With the designation of a Science Diplomacy Division to act as a liaison between national S&T stakeholders and international partners, the Ministry of Foreign Affairs of Pakistan launched its 'Science Diplomacy Initiative' in 2019. In Colombia, science diplomacy was included as a priority in the government's agenda in 2020. These 'emerging' or 'developing' countries belong to different continents and exhibit marked differences in the size and the level of S&T development (Table 1).

We conducted 12 online semi-structured interviews with high-level officials and experts from BR (3), CO (4), IN (3), PK (1), and ZA (1) over the period from October 2021 to March 2022. We offered them a list of questions with pre-selected answers allowing for grasping the objectives and strategic drivers of science diplomacy in each country. In Table 2, we give a quantitative expression of selected interviewees' answers. Our interlocutors were asked to rank the degree of priority of objectives, the importance of motivations inspiring national science diplomacy, or the importance of some explanatory factors. We gave a value to answers ranging from 0 (total rejection of the proposed statement) to 4 (total acceptance). For each item in the table, we calculated an average score of responses obtained using two different methods. We computed an average score per country, then averaged the five national scores (Column 3). We also calculated the average score from the pooling of responses given by each of the 12 interviewees (Column 4). This second method gives more weight to the final result to the countries best represented among the respondents. However, few differences appeared between the scores obtained by each of the methods, which indicates a fairly good homogeneity of responses, regardless of the country. Using the figures of Column 4, we summarise and comment on inputs collected, distinguishing between aspects of science diplomacy oriented towards the satisfaction of domestic needs and aspects oriented towards the positioning of the country on the international scene.

Table 1. The basic indicators of the size and S&T development of five countries of the Global South.

Country	Population[a]	GDP per capita[b]	R&D expenditure, % of GDP[c]	Researchers per million inhabitants[d]	Science and engineering articles, % of world total[e]	Global Innovation Index ranking[f]
Brazil	212,559	6,796	1.16	887	2.4	62
Colombia	50,882	5,334	0.23	88	0.3	68
India	1,380,004	1,927	0.65	252	5.1	48
Pakistan	220,892	1,188	0.24	335	0.4	107
South Africa	59,308	5,655	0.83	432	0.5	60

[a]Total number, 2020. Source: World Bank Database.
[b]Current USD, 2020. Source: World Bank Database.
[c]Pakistan and South Africa: 2017; Brazil, Colombia, and India: 2018. Source: World Bank Database.
[d]Brazil: 2014; Colombia, Pakistan, and South Africa: 2017; India: 2018. Source: UNESCO Database.
[e]Brazil and India: 2020; Colombia, Pakistan, and South Africa: 2016. Source: National Science Board, *Science and Engineering Indicators*, 2018 and 2021.
[f]2020. Source: Cornell University, INSEAD, and WIPO.

Table 2. Objectives and strategic drivers of five Global South countries' science diplomacy.

Objective	Categorisation	Score ($n = 5$)	Score ($n = 12$)
Improve the national innovation capacity	National interests—economic and development	4	4
Promote economic development	National interests—economic anddDevelopment	3.9	3.9
Serve your country's interests and needs	National interests—general	3.9	3.9
Build or improve the national scientific capacity	National interests—science and technology	3.9	3.9
Address global challenges and promote the common interests of humanity	Common interests	3.4	3.4
Disseminate the core principles of the SDGs	Common interests	3.4	3.3
Correct the asymmetries of development and power in the world	Political-diplomatic	3.3	3
Mitigate international political tensions through S&T cooperation	Political-diplomatic	2.6	2.4
	Strategic driver		
Promote S&T international collaboration	Cooperation	3.8	3.8
Develop international knowledge circulation	Cooperation	3.2	3.5
Promote scientific cooperation between the North and the South	Cooperation	3.1	3.3
Actively participate in the governance of global issues	Cooperation	3.6	3.3
Gain visibility on the international scene	Influence	3.5	3.4
Improve the country's representation in international agenda settings	Influence	3	3.3
Improve the country's participation in international decision-making	Influence	2.9	2.8
Country's ability to influence discussions and governance of major global issues	Influence	2.8	2.7
Attract foreign scientific resources (human, financial) to the country	Attraction	3.6	3.6
Attract foreign investment in R&D infrastructure	Attraction	3.4	3.3
Attract foreign scientific talents (including doctoral students) to the country	Attraction	3.0	3.0
Connect with the scientific diaspora	Access	3.5	3.7
Enhance the participation of the country's researchers in international scientific networks	Access	3.5	3.3
Stop/reverse the brain drain of scientists	Access	1.5	3.3

4.1 Science diplomacy and the satisfaction of domestic needs

Table 2 (upper part) brings together several science diplomacy objectives submitted to the appreciation of interviewees. With scores of 3.9 and more, national development objectives (strengthening the national research and innovation system; economic development) appeared quite prominently on top of priorities. They represent a strong marker of Global South countries' expectations regarding science diplomacy. Items listed in the lower part of Table 2 allow us to understand the importance of strategic drivers. Not surprisingly, items relating to the cooperation driver obtained significant scores—from 3.3 to 3.8. Confirmation of the central role of international scientific cooperation as a way to foster economic development can be found in the literature: from the point of view of Brazil, 'international cooperation is seen as critical for assessing financial resources and technologies the country does not possess because of its lower development level' (Leite et al. 2020: 60), and 'with South Africa being responsible for no more than 0.5 percent of global research output at the

time, international cooperation was, and remains, essential for South African science to prosper' (Pandor 2012).

Attracting foreign resources has been recognised by interviewees as a 'high priority' driver, although with nuances. It is first and foremost investments in R&D infrastructures that must be attracted (score: 3.3) and, to a lesser extent, foreign scientific talents (3.0). These statements echo pieces of the literature stating that 'the purpose of innovation diplomacy is (…) to attract research and development to Brazil' (Leite et al. 2020: 61, quoting da Silva and Ivo 2018), that 'the emphasis for South Africa's science diplomacy remains on leveraging access to resources' (Masters 2016), or that 'in India, science diplomacy policy is focused in the importance of the acquisition, exchange and development of technologies through strategic alliances' (King et al. 2021).

Evidence of the importance of the access driver in national strategies is given by the high scores granted to statements such as 'Connect with the scientific diaspora' (3.7) or 'Enhance the participation of the country's researchers in international scientific networks' (3.3). The importance of connecting with national scientists abroad is reflected in policy mechanisms such as the Innovation Diplomacy Program of the Brazilian Ministry of Foreign Affairs, which aims at 'assisting the mobilisation of the Brazilian scientific diaspora abroad'. One of the challenges of Colombia's science diplomacy is 'coordinating the scientific diaspora and Colombian academic communities with international networks' (Cristancho Marulanda 2021). India's Science, Technology, and Innovation Policy also foresees intensifying the engagement with the scientific diaspora (Government of India—Ministry of Science and Technology 2020).

4.2 Science diplomacy and the positioning on the international scene

We bring together those elements of countries' science diplomacy strategies that relate to the projection of the international stance, the consideration given to common interests, the involvement in major global issues, and the capacity for exerting international influence. Interviewees largely agreed that their countries' objectives and expectations are in line with those of the other countries in the Global South (3.6). This perception of shared interests is undoubtedly what explains why 'carrying out joint initiatives within a regional framework' (3.7) appeared at the top of the list of the 'most suitable ways to increase the effectiveness of science diplomacy in the Global South'. 'Build alliances with other countries of the South with a view to addressing global challenges' (3.6) and 'give priority to South–South science diplomacy initiatives' (3.3) were also actions that arouse strong support among interviewees.

We tried to learn about some of the geopolitical/diplomatic objectives of the countries under review. Historical promoters of science diplomacy highlight that international scientific cooperation can have diplomatic value when it helps mitigate tensions between countries. But the low score (2.4) obtained by the 'mitigate international political tensions through S&T cooperation' item suggests that this rationale does not hold for countries of our survey. In contrast, the 'address global challenges and promote the common interests of humanity' (3.4) and 'disseminating the core principles of the sustainable development goals (SDGs)' (3.3) items received higher rates, giving evidence of a constructivism-driven will to contribute to the building of global standards. We note, however, that the objectives centred on the satisfaction of common interests received lower ratings than the ones centred on the satisfaction of national interests (Table 2, upper part), thus giving evidence of the strength of realism in inspiring the orientations of science diplomacy of the countries under review.

Do countries of our survey have the will to use science diplomacy to question and transform the international order? Some credit must be given to this assumption, since the following two objectives were deemed 'relevant' by interviewees: 'correct the asymmetries of development and power in the world' and 'rebalance power relations between North and South' (3.3 each). In this process, South–South cooperation has been deemed significant by Brazilian diplomats for 'strengthening Southern bargaining power in multilateral negotiations, such as environmental ones, where the political use of science favours the interests of powerful countries' (Leite et al. 2020: 63). The global rebalancing of forces that science diplomacy could promote fit perfectly into the realist reading grid of IRs. But what about Global South countries' ability to exert influence, so necessary to change the international order? Interviewees gave a low rating (2.7) in their assessment of their 'country's ability to influence discussions and governance of major global issues'. They did not attribute this lack of influence to an 'insufficient presence of national experts in international organisations' (2.3), to a 'low participation in formal or informal international networks' (2.4), or to a 'lack of adequate diplomatic resources' (1.8). They even less attributed it to a 'lack of solidarity with other emerging or developing countries' (1.1). 'Insufficient national science and technology development' (2.8) was deemed the major reason preventing their country to be more influential on the governance of global issues. It is therefore not surprising that high scores were given to initiatives to 'gain visibility on the international scene' (3.4), to 'improve the country's representation in international agenda settings' (3.3), and to 'actively participate in the governance of global issues' (3.3).

While recognising the low capability of their country to influence the diplomacy of global challenges, all interviewees expressed nuances depending on the area. To the question of 'What are the global issues for which your country's diplomacy is most influential?', answers were environment and climate change (BR, IN, and ZA), energy (IN), health (BR and IN) and especially in relation to COVID-19 (IN and ZA), nuclear disarmament (BR), international security (IN and PK), internet governance (BR), African agenda (ZA), tropical diseases, and Amazonian issues and biodiversity (CO). Responding to the question 'What are the global issues for which progress in influence is most needed for your country?', answers were nuclear energy and nuclear affairs (IN), space affairs (IN and BR), sustainable development (BR), climate change (IN and CO), disruptive technologies (ZA) and technologies for SDGs (IN and CO), public health (CO), and migration issues (CO).

These responses highlight what characterises the objectives and the strategic drivers of science diplomacy of the five Global South countries. The most remarkable results are the following:

1. Indisputably, science diplomacy is assigned an objective of building up national S&T capacity and more broadly of enhancing economic development.

2. In addition to cooperation, strategic drivers oriented towards the acquisition of S&T resources (attraction and access) are of utmost important.
3. Countries are eager to improve their position on the international scene, while admitting that the insufficient level of their S&T development is an obstacle to this ambition.

These results prompt several comments. First, the answers of interviewees showed a remarkable convergence. We believe that they give a fairly good idea of the ambitions and challenges that characterise science diplomacy of Global South countries. Our empirical results pave the way for subsequent studies of national models of science diplomacy in the South, which may differ significantly from what is known about national models of developed countries (Flink and Schreiterer 2010; Krasnyak 2018a). Second, our survey shed in particular some light on the relationship between the level of S&T development of countries and their commitment to science diplomacy. Science diplomacy is taking shape in each of the five countries, which experiences show that having a high level of S&T development is not a prerequisite for embracing such a strategy. Third, strategies are mainly shaped by cooperation, access, and attraction drivers. The role of the influence driver is weak, or marginal in the strategy mix of these countries: as the realist framework reminds us, having a certain level of material forces and capabilities (in this case: S&T resources) is required for a country to be influential on the global scene.

5. Conclusion

The theoretical convergence of realist axioms of material forces and constructivist ideational factors allows for the most close comprehension and theoretical assumption of science diplomacy. Showing limitations to both tracks, neither realism nor constructivism alone looks convincing in framing science diplomacy and understanding its role in international politics. A realist approach to comprehending how states formulate their foreign policies and how they behave on the international stage is sufficient in understanding conceptions of the balance of power. Although, realist policy lacks in explaining international norms, the involvement of additional institutions, non-state actors, and the driving forces of ideational power in foreign policy decision-making. A constructivist approach has its limitations in assessing the change in international order strategies and in the balance of power. Instead, a mixed realist-constructivist approach overcomes these limits. The axioms of realism and distinctive themes of constructivism are combined. Bonding together, ideational factors and material balances of power suggest various interpretations of realities which are more important than realities themselves (Houghton 2017). The proposed framework is highly reflexive and it expands rather narrow relational practices of science diplomacy towards the wider context of the changing environment of the real world as it *is*, and as we want it *to be*.

The realist-constructivist framework has mutual points in reliance on diplomacy and acknowledging the community of nations with shared moral identity and global responsibility. From positions of realism, shared moral identity and responsibility come from a desire and the need of acting rationally when cooperative behaviour among states maximises power and benefits, promotes national interests, and increases security. A constructivist approach to moral identity and shared responsibility is based on socially constructed norms and ideational aspirations for achieving a common good. Constructivism does not reject the axiom of national interests, yet attempts to assess what constitutes national interest through norms, ideas, moral identities, and common interests. Realism stresses the importance of interests and power but does not deny the normative dimension of IRs and political action (Brown 2012). The realism and constructivism conjunction allows two basic settings for IR theory to bond together complementing foreign policy analysis and science diplomacy further conceptualisation.

On the conceptual level, suggested analytical categories of science diplomacy namely objectives, strategic drivers, and tools stem from a nation-state's foreign policy aspirations and S&T capabilities. We consider those aspirations and capabilities as preexisting at a given period of time. The realist-constructivist approach sees the set of categories not only preexisting but also contaminated with ideas, identities, and cultural interpretations specific to each country or region. The varieties of ideas and collective identities, however, are somehow controlled by created norms making a realist-constructivist symbiosis in science diplomacy viable. The emerging and developing countries of the Global South acknowledge the organising principles of science diplomacy patterns, yet preexisting material conditions, e.g. population, GDP per capita, R&D expenditure and innovations, and a number of research institutional agencies and researchers, make implementations of science diplomacy contrasting and distinguishing one from another.

The empirical part and data collection illustrated that developing and emerging countries of the Global South might struggle to address the issues of global concerns bearing in mind the long-term outcomes. Moreover, such countries might not have global issues as a priority in their policy-making because of the scarcity of resources or the preoccupation with domestic issues that require immediate delivery. In view of the elements collected in our empirical study, we are inclined to think that the axioms of realism strongly inspire Global South countries' science diplomacy, which must imperatively be put at the service of national development. Lesser powers, nonetheless, even in the political rhetoric cannot completely ignore the importance of global issues not only because of the potential reputational damage and shattered international standing but also because of the projected damage for physical and ontological security, which often depends on international cooperation and international reputation and standing. Adding to this, the desire of these countries to improve their positioning in the global S&T order and enhance their participation in the decision-making on major challenges encourages them to adopt a constructivist mindset.

Despite limited possibilities and other factors that predetermine and constrain foreign policy behaviour of developing and emerging powers, they also more likely aspire to upgrade their status and maximise capabilities, which is possible through economic development, progress, and innovations. A possibility of an upgraded international status potentially expands and deepens the foreign policy agenda of emerging and developing powers of the Global South by adding global

challenges and shared responsibility on the foreign policy agenda—the factors that correspond with science diplomacy aspirations.

Data availability

The data underlying this article will be shared on reasonable request to the corresponding author.

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