Silence that matters

Understanding conversations in interdisciplinary collaboration

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NICK VEROUDEN

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Dissertation

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by

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For Sara & Samuel

‘I want to raise the issue of silence.’
– Robert Ryman

‘Silence, yes, but what silence!
For it is all very fine to keep silence,
but one has also to consider the kind of silence one keeps.’
– Samuel Beckett

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Summary

This PhD thesis is a study of the functions and consequences of silence in the implementation and development of interdisciplinary research collaborations that result from the increased commitment of universities to solving today's social problems.

Around the world, universities are increasingly seen as agents of social change that can have a unique role in fostering the knowledge and innovation necessary to address the world's biggest problems. Society expects universities to invest their intellectual and financial resources to meet global challenges such as climate change, poverty, looming worldwide shortages of clean water, and so on. This licence to action creates challenges for universities. New and capable coalitions amenable to realizing innovative research and education are needed between researchers across disciplines and faculties within the university, between knowledge institutions in the region, and in a broader sense between universities internationally. Realizing these alliances requires fruitful interdisciplinary collaboration in which different interests, visions, and practices are bridged.

However, research shows that interdisciplinary collaboration is extremely difficult to achieve, and that well-intentioned initiatives do not always result in common understandings that generate new solutions that are likely to address today's social challenges. Hence, the purpose of this research is to provide more understanding of how day-to-day interdisciplinary collaboration processes unfold, exploring how these processes are conversationally constructed. In developing and implementing complex interdisciplinary collaborative efforts within and across universities, actors with different backgrounds constantly have to talk

to one another to reach agreement on the way forward. Much has been written about conversations for collaboration, making clear that these conversations are powerful mechanisms through which collaboration comes about, but we know little about the mechanisms that shape the course of these interdisciplinary conversations.

In this PhD thesis, *silence* is presented as a key mechanism that helps to understand the course of interdisciplinary conversations. Typically, conversations are considered to require the open and transparent exchange of ideas and information. One can easily understand why. In order to collaborate, scientists have to clarify and share their ideas and approaches to enable them to share data, results, methods, ideas, and tools effectively. Collaboration is premised on the drawing out of verbal interactions – on information being accessible to all interested parties, on participants collating all the relevant evidence, putting it on the table, and discussing it openly.

However, in our focus on spoken conversation, we tend to forget that there are also things *not* said during interaction. In this PhD thesis, it is suggested that sometimes what is not said when scientists are working towards common goals and objectives is often as important as what is said. Understanding the shades of silence is indispensable for gaining more understanding about the course of interdisciplinary conversations; by failing to acknowledge these silences within the functioning of collaboration, a significant aspect of what collaboration is about is overlooked. Hence, in the introduction, I present the following research questions. What are the main functions of silence in interdisciplinary conversation, and what are the effects of these silences for the course of interdisciplinary conversation?

The functions and effects of silence in interdisciplinary research collaboration are studied in the context of the Delft University of Technology (TU Delft). The TU Delft is the largest technical university of the Netherlands and is currently trying to connect parts of its research and education to relevant engineering problems in our society. Given the need to ignite new and constructive interdisciplinary collaborative efforts, the TU Delft provides a fruitful context in which to explore conversations between scientists with different interests, views, and perspectives, coming from various disciplinary and professional fields and domains, but faced with the shared task.

This thesis examines the significance of silence for collaboration from an empirical perspective. The functions and meanings of silence for collaborators themselves are central. Understanding the complex and messy everyday reality of collaborating requires a methodological approach that can elucidate the role of silence in interdisciplinary conversations and the resulting consequences for the dynamics of wider social networks. To examine the tangible, everyday conversational process of collaboration, an ethnographic research approach was used, which foregrounds the interpretative and constructivist dimensions of the research process. Research was conducted by way of three in-depth case studies, which unearthed the intricacies of the interdisciplinary conversations of those involved in developing and implementing interdisciplinary collaboration.

Chapter 2 presents a case study of silence in an intra-university collaboration, focusing on the joint effort of engineers, spatial planners, and social scientists to reframe the university's traditional area of expertise in the field of water management in accordance with current societal changes and expectations. The chapter shows that silence serves various functions such as securing group performance, keeping disagreements from surfacing, and managing conflicts of interest in the negotiation process. Despite such benefits, the chapter reveals that these silences shaped the course of interaction in ways that were not intended, causing that diverging viewpoints and interests were not explored and discussed. This resulted in a latent conflict between parties.

The third chapter discusses a case study of silence in regional inter-university collaboration, examining its significance in the process-based introduction of an interdisciplinary educational course at the interface of health and technology. It demonstrates that silence is actively used by interacting actors in their conversations with others to realize a productive and efficient work process across three universities, for example to deflect attention from difficult issues or create room for manoeuvre. The chapter furthermore shows that what is left unsaid in specific situations and settings influences conversations in the wider network, where it heightens uncertainty, hinders operational concretization, and decreases motivation and commitment.

The fourth chapter offers theoretical insights into the connection between silence and social learning, describing how silence enables and constrains collaborative learning processes in groups, teams, or networks. Understanding silence in relation to the content, relationships, and process-related dimensions

of ongoing interaction, it was shown, provides a firm basis for developing learning approaches that enable successful implementation of interdisciplinary projects and efforts.

Chapter 5 discusses a case study of silence in the context of an international collaboration between universities, which foregrounds the intercultural conversations between Dutch and Chinese scientists in their efforts to develop and implement a joint Sino-Dutch research centre in the area of sustainable and green cities. The chapter draws attention to the varying meanings that are attached to silence during ongoing interaction and reveals that, if these meanings are not adequately understood and scrutinized, this can lead to misinterpretation, negative judgements, and stereotyping, increasing rather than bridging differences.

The general conclusion based on the separate studies is that silence must be considered as an intrinsic part of interdisciplinary collaboration. Collaboration around complex social issues, in which different perspectives, values, and interests are represented, gives rise to situational expectations in which actors must repeatedly decide on the best way forward. In the middle of interaction, it is not always possible to discuss issues and problems openly, and sometimes not even desirable. Although silence may be necessary for contending with the complexities of practice, its use may defeat its purpose. The case studies illustrate that silence can unintentionally create or worsens problems, resulting in failure to bridge and integrate differences and work towards common solutions and agreement.

The chapters in this thesis provide a partial answer to my research questions. In the conclusion, the results of the different cases are integrated. Four main functions and effects of silence in interdisciplinary collaboration are distinguished. The first function is epistemic and refers to silences that arise when the objective is to integrate and share knowledge across disciplinary, faculty, and professional boundaries. Here, silence serves the function of retaining a respectful distance between one another in interaction when the boundaries of expertise are not clear. The second is relational, indicating its role in entangled alliances. It refers to the silences that are used to mitigate and manage relationships between different actors and parties of actors within the network. The third function of silence is tactical and serves a role in processes of management, coordination, and decision making, such as keeping the working process within time schedules, enhancing participation, creating room for manoeuvre. The fourth and final function is interpretative and refers to the silences used to actively impart meaning to the

process by conveying communicative content in an implicit and indirect way. In addition, the conclusion shows how these four kinds of silence affect the collaboration process in often unintended ways, closing off alternative knowledge paths that could potentially lead to the formulation and development of new ideas and perspectives, creating unspoken fault lines that can develop into latent conflicts, leading to ill-considered decision making and poorly designed and fragmented work processes, and as the source of misinterpretation and judgements.

In addition to outlining these four main functions and effects of silence, the conclusion discusses the practical implications of silence for optimizing future collaboration processes. It is posited that silence attunes us to the importance of conversational responsibility, which refers to the heightened awareness of collaborators' motivations for, and the consequences of, their conversational behaviour. Constantly being aware of, and reflecting on, the consequences of silence within ongoing conversations can trigger learning processes that create more awareness of how common goals are conversationally constructed, providing fertile ground for developing more constructive ways of talking and listening that allow interdisciplinarity to emerge. The implications for learning are discussed separately for collaborators themselves, communication professionals, and university policy. The last part of the conclusion sets out some avenues for further research and ends with a reflection on my struggle with my own silences while carrying out this research.

Samenvatting

Dit proefschrift is een studie van de functies en gevolgen van stilte bij de uitvoering en ontwikkeling van interdisciplinaire onderzoekswerkzaamheden, voortvloeiend uit de toegenomen inzet van universiteiten om bij te dragen aan de oplossing van hedendaagse maatschappelijke kwesties.

Over de hele wereld worden universiteiten steeds meer gezien als actoren van maatschappelijke verandering die een unieke rol kunnen spelen bij het ontwikkelen van kennis en innovatie die nodig zijn om de grootste problemen van de wereld aan te pakken. De samenleving verwacht dat universiteiten hun intellectuele en financiële middelen zullen investeren om tegemoet te komen aan mondiale uitdagingen waaronder klimaatverandering, armoede, het wereldwijd tekort aan schoon water en zo meer. Deze vrijbrief voor actie stelt universiteiten voor uitdagingen. Nieuwe en capabele coalities, in staat om innovatief onderzoek en onderwijs te verwezenlijken zijn nodig, tussen onderzoekers van verschillende disciplines en faculteiten binnen de universiteit, tussen kennisinstellingen in de regio en tussen universiteiten internationaal. Een vereiste om deze allianties te realiseren is een vruchtbare interdisciplinaire samenwerking waarin verschillende interessegebieden, visies en praktijken worden overbrugd.

Uit onderzoek blijkt echter dat interdisciplinaire samenwerking zeer moeilijk te bereiken is en dat goedbedoelde initiatieven niet altijd leiden tot gemeenschappelijke begrippen die nieuwe oplossingen genereren voor de aanpak van de huidige maatschappelijke uitdagingen. Vandaar dat het doel van dit onderzoek was meer inzicht te krijgen in hoe de dagelijkse interdisciplinaire samenwerkingspro-

cessen zich ontvouwen, en te onderzoeken hoe deze processen door omgang en gesprek (conversationeel) geconstrueerd worden.

Bij het ontwikkelen en implementeren van complexe interdisciplinaire samenwerkingsverbanden binnen en tussen universiteiten moeten actoren met verschillende achtergronden voortdurend met elkaar praten om overeenstemming te bereiken over de weg voorwaarts. Er is veel geschreven over gesprekken ten behoeve van samenwerking. Duidelijk is dat gesprekken krachtige mechanismen zijn waarbinnen samenwerking tot stand komt. Maar we weten weinig over de mechanismen die vorm geven aan het verloop van deze interdisciplinaire gesprekken.

In dit proefschrift wordt *stilte* gepresenteerd als een belangrijk mechanisme dat de interdisciplinaire gesprekken helpt begrijpen. Over het algemeen worden gesprekken beschouwd als open en transparante uitwisselingen van ideeën en informatie. Het is gemakkelijk te zien waarom: om samen te werken, moeten wetenschappers hun ideeën en benaderingen verduidelijken en delen zodat ze kunnen komen tot een effectieve samenwerking rondom data, resultaten, methoden, ideeën en wetenschappelijke gereedschap. Samenwerking staat of valt met verbale interactie - met informatie die toegankelijk is voor alle belanghebbenden, en met de deelnemers die alle relevante informatie bijeenbrengen, op tafel leggen en bespreken.

In onze focus op gesproken conversatie hebben we echter de neiging te vergeten dat er ook dingen tijdens interactie *niet* gezegd worden. In dit proefschrift wordt naar voren gebracht dat soms datgene wat niet gezegd wordt wanneer wetenschappers voor gemeenschappelijke doelstellingen werken, net zo belangrijk is als wat wel wordt gezegd. Het besef van stilte is onontbeerlijk om meer begrip te krijgen van de wijze waarop interdisciplinaire gesprekken verlopen. Wanneer we deze 'stilheden' in het functioneren van de samenwerking niet erkennen, zien we een belangrijk aspect van de samenwerking over het hoofd. Dus stel ik in de introductie de volgende onderzoeksvragen: Wat zijn de belangrijkste functies van stilte in interdisciplinair gesprekken en wat zijn de gevolgen van deze stilte voor de loop van die gesprekken?

De functies en effecten van stilte in interdisciplinaire onderzoekssamenwerking zijn bestudeerd in de context van de TU Delft. De TU Delft is de grootste technische universiteit van Nederland en streeft ernaar onderdelen van onderzoek en opleiding aan te doen sluiten op relevante technische problemen in onze

samenleving. Gezien de noodzaak om nieuwe en constructieve interdisciplinaire samenwerking aan te gaan, biedt de TU Delft een vruchtbare context om gesprekken tussen de wetenschappers met verschillende interesses, standpunten en perspectieven te verkennen - wetenschappers afkomstig uit verschillende disciplines, vakgebieden en domeinen die zich gesteld zien voor een gemeenschappelijke taak.

Dit proefschrift onderzoekt het belang van stilte voor samenwerking vanuit een empirisch perspectief. De functies en betekenissen van stilte voor de participanten zelf staan centraal. Het begrijpen van de complexe en rommelige alledaagse realiteit van samenwerking vraagt om een methodologische benadering die een diepgaand inzicht kan geven in de rol van stilte in interdisciplinaire gesprekken en de daaruit voortvloeiende gevolgen voor de dynamiek binnen bredere sociale netwerken. Om het tastbare, dagelijkse conversatieproces van samenwerking te onderzoeken is een etnografische onderzoeksbenadering gebruikt die de interpretatieve en constructivistische dimensies van het onderzoeksproces benadrukt. Het onderzoek werd uitgevoerd door middel van drie diepgaande case studies, die de verwikkelingen ontleden van de interdisciplinaire gesprekken zoals die worden gevoerd door degenen die betrokken zijn bij het ontwikkelen en implementeren van interdisciplinaire samenwerking.

Hoofdstuk 2 presenteert een casus van stilte in een intra-universitaire samenwerking die zich richt op de gezamenlijke inspanning van ingenieurs, ruimtelijk planners en sociaal-wetenschappers om het traditionele vakgebied van de universiteit op het gebied van waterbeheer te hervormen in overeenstemming met de huidige maatschappelijke veranderingen en verwachtingen. Het hoofdstuk toont aan dat stilte verschillende functies dient waaronder het veilig stellen van collectieve prestaties, het vermijden van onenigheid en het beheersen van belangenconflicten in het onderhandelingsproces. Ondanks deze voordelen blijkt uit deze studie dat deze stiltes de loop van de interactie vormden op een manier die niet bedoeld was. Verschillen in perspectief en uiteenlopende belangen werden niet besproken, wat resulteerde in een latent conflict tussen partijen.

Hoofdstuk 3 bespreekt een casestudy van stilte in regionale interuniversitaire samenwerking: het ontwikkelen van een interdisciplinaire opleiding op het snijvlak van gezondheid en technologie. Hier wordt aangetoond dat stilte actief wordt gebruikt door betrokkenen in gesprekken die tot doel hebben anderen te betrekken in een productief en efficiënt werkproces op drie universiteiten. Stilte wordt bijvoorbeeld ingezet om de aandacht van moeilijke problemen af te leiden of om

ruimte te scheppen. In dit hoofdstuk blijkt verder dat wat er in bepaalde situaties niet gezegd wordt, gesprekken beïnvloedt in het bredere netwerk in de zin dat het de onzekerheid vergroot, de concretisering belemmert en afbreuk doet aan motivatie en inzet.

Hoofdstuk 4 biedt theoretische inzichten in de verbanden tussen stilte en sociaal leren. Hier komt aan de orde hoe stilte collaboratieve leerprocessen in groepen, teams of netwerken zowel mogelijk maakt als beperkt. Inzicht in de stilte in relatie tot de inhoud van het gesprek, de verhoudingen tussen gesprekspartners en procesgerelateerde dimensies van de lopende interactie biedt, zo blijkt, een stevige basis voor het ontwikkelen van leerbenaderingen die een succesvolle implementatie van interdisciplinaire projecten en inspanningen mogelijk maken.

Hoofdstuk 5 bespreekt een casestudy van stilte in het kader van een internationale samenwerking tussen universiteiten, in dit geval de interculturele gesprekken tussen Nederlandse en Chinese wetenschappers met als doel een Chinees-Nederlands onderzoekscentrum op het gebied van duurzame en groene steden tot stand te brengen. In dit hoofdstuk komen de wisselende betekenissen aan de orde die in lopende interactie verbonden zijn aan stiltes. Als deze betekenissen niet voldoende begrepen en onderzocht worden, kan dat leiden tot misinterpretatie, negatieve oordelen en stereotypering, in plaats van tot het overbruggen van verschillen.

De algemene conclusie, gebaseerd op een integratie van inzichten uit de afzonderlijke studies, is dat stilte moet worden beschouwd als een intrinsiek onderdeel van interdisciplinaire samenwerking. Samenwerking rond complexe sociale vraagstukken waarin verschillende perspectieven, waarden en belangen vertegenwoordigd zijn, leidt tot situatieverwachtingen waarin actoren herhaaldelijk moeten beslissen over de beste weg voorwaarts. Te midden van de interactie is het niet altijd mogelijk problemen openlijk te bespreken, en soms zelfs niet wenselijk. Hoewel stilte nodig kan zijn om de complexiteit van de praktijk te beheersen, kan het gebruik ervan aan dat doel voorbijgaan. De casestudies illustreren dat stilte onbedoeld problemen kan veroorzaken of verergeren, met als gevolg het mislukken van de inzet om verschillen te overbruggen en te integreren ten bate van gemeenschappelijke oplossingen en afspraken.

De verschillende studies geven een gedeeltelijk antwoord op mijn onderzoeksvragen. In de conclusie worden de resultaten van de verschillende casus geïntegreerd. Vier hoofdfuncties en effecten van stilte in interdisciplinaire samen-

werking worden onderscheiden. De eerste functie is epistemisch, en verwijst naar stiltes die zich voordoen bij het zoeken naar integratie en het delen van kennis over disciplinaire, faculteit en professionele grenzen heen. Hier heeft stilte de functie om een respectvolle afstand jegens de ander te behouden waar de grenzen van deskundigheid niet geheel duidelijk zijn. De tweede functie is relationeel, ingebed in allianties met allerlei dwarsverbanden. Deze functie verwijst naar stiltes die gebruikt worden om relaties tussen verschillende actoren en partijen in het netwerk te versoepelen en te beheren. De derde functie van stilte is tactisch en heeft een rol in het beheer en coördinatie en besluitvorming, zoals het waarborgen van tijdschema's binnen de werkafspraken, het vergroten van de participatie en het creëren van manoeuvreerruimte. De vierde en laatste functie is interpretatief, en verwijst naar de stilte die gebruikt wordt om betekenis te geven aan het proces door communicatieve inhoud op impliciete en indirecte wijze over te dragen.

Vervolgens laat ik zien hoe deze vier soorten stilte het samenwerkingsproces op vaak onbedoelde manieren beïnvloeden. Ze kunnen alternatieve kennispaden afsluiten die potentieel kunnen leiden tot de formulering en ontwikkeling van nieuwe ideeën en perspectieven. Ze creëren onuitgesproken breuklijnen die zich kunnen ontwikkelen tot latente conflicten. Ze leiden tot ondeugdelijke besluitvorming en slecht ontworpen en gefragmenteerde werkprocessen. Ze zijn een bron van misinterpretatie en verkeerde beoordeling.

Naast deze vier hoofdfuncties en effecten van stilte worden de praktische implicaties besproken van stilte die samenwerkingsprocessen zou kunnen optimaliseren. Het is van belang stil te staan bij de conversatieverantwoordelijkheid, het verhoogde bewustzijn van betrokkenen zowel aangaande de motieven als de gevolgen van hun conversatiegedrag. Een constant bewustzijn van en reflectie op de gevolgen van stilte in gesprekken kan leiden tot leerprocessen die meer bewustzijn creëren van de manieren waarop gemeenschappelijke doelen conversationeel worden geconstrueerd, hetgeen vruchtbare grond oplevert voor het ontwikkelen van meer constructieve manieren om te praten en te luisteren, en interdisciplinariteit tot bloei te laten komen. De implicaties voor het leren worden apart besproken voor de betrokkenen bij samenwerkingsprojecten, voor communicatiedeskundigen en voor het universitair beleid. Het laatste deel van de conclusie brengt enkele paden voor verder onderzoek in kaart en bevat tevens een reflectie op de worsteling met mijn eigen stiltes tijdens het uitvoeren van dit onderzoek.

01

INTRODUCTION

Introduction

Around the world, universities are increasingly seen as agents of social change that can have a unique role in fostering the knowledge and innovation needed to address the world's biggest problems. As 'stores of expertise and knowledge capital' (Bradwell, 2009, p. 9), society expects universities to invest their intellectual and financial resources to meet global challenges such as climate change, extreme poverty, childhood diseases, and an impending worldwide shortage of clean water (Thorp & Goldstein, 2010). In recent years, governments and funding agencies have placed increasing pressure on universities to become more geared to effectively adapting to interdisciplinary challenges (Feller, 2006; Sa, 2007), pushing for collaboration among academics and between institutions (Bradwell, 2009). In the Netherlands, the Dutch government has recently released an influential report – Vision for Science: Choices for the Future 2020 – on how Dutch science can maintain its international position. According to this report, it is of vital importance that universities 'facilitate creative connections across traditional boundaries' leading to scientific breakthroughs that contribute in solving today's mayor social issues. The report is just one example of how universities are called upon to reshape themselves and encourage researchers to engage in interdisciplinary collaborations across organizational boundaries (Sa, 2007).

This licence to action creates many challenges for universities, as they have to foster new and capable coalitions amenable to realizing innovative research and education. Given the increased pressure to promote interdisciplinary research and education, recent studies point to the widespread adoption of collaboration as an

institutional strategy (Feller, 2006; Sa, 2007) that can straddle disciplinary and professional boundaries within the institution, between universities in the same region, and between universities around the globe (Katz & Martin, 1997).

First of all, the problems of our times are complex, and addressing them requires researchers across various disciplines, faculties and universities to collaborate. Academic approaches are anchored in specific disciplines. Horizontal collaboration between disciplines and faculties can reverse such overspecialization, transcending silos of discipline-specific knowledge and competency. In addition to creating new internal connections within the university and breaking down silos that inhibit exchanges of knowledge, universities must bridge the gap between academia and society, creating new alliances and partnerships with universities and other knowledge institutions in the region. Such partnerships are encouraged by European research policies, which emphasize how building new and intensive alliances with other universities within the same geographical region benefits the sharing and integration of knowledge and expertise (Hirsch & Weber, 2002). This is seen in the development of joint educational programmes between academic institutions, in which integrated curriculums enable prospective students to tackle complex research questions of the future (McFadden, Chen, Munroe, Naftzger & Selinger, 2010). In a broader sense, universities are encouraged to develop international academic projects and partnerships. Globalization is extending academic work to a wider range of countries (Ennew & Fujia, 2009), and this requires institutional responses to international developments to build new connections that can put institutions in a better position to tackle major worldwide challenges. The internationalization of higher education, for example, drives universities to build and expand research infrastructure in foreign countries such as China, Brazil, and India, establishing joint research centres and branch campuses.

From the above, we can see that optimizing interdisciplinary collaboration is becoming an imperative for universities. As policymakers, funding bodies, and university policy state, it can lead to new and exciting research questions, unlock creativity, cut potential blind spots, provide access to scarce instruments, generate new types of investment and research funding, and combine and integrate the best academic thinking for the public good. Despite holding such promise, interdisciplinary collaboration is difficult to accomplish because of its complexity. Scholars of scientific collaboration have made some well-documented analy-

ses of initiatives that struggle to achieve true interdisciplinary integration (Klein, 1990; Macfadden et al., 2010; Simakova, 2012; Shrum, Genuth & Chompalov, 2007; Stokols, Misra, Moser, Hall, & Taylor, 2008). These studies point out that collaboration between actors with different disciplinary and professional backgrounds, values, and interests is not always satisfactory and rarely results in new, shared interpretations of the situation that give direction to new and commonly accepted solutions. As Gray (1989) puts it, many multiparty collaborations 'are exercises in frustration and often exacerbate rather than improve the situation' (p. 24). Given the gap that exists between the ideals and the realities of interdisciplinary collaboration, more understanding of the day-to-day collaboration process is needed to explain why well-meant attempts at interdisciplinary collaboration do not always produce the desired result.

Interdisciplinary conversations

In this thesis, the everyday practice of interdisciplinary collaboration is examined from a communication perspective. Communication is frequently considered a key dimension in meeting the most complex needs and challenges of universities. Given the need to create new connections and build resilient partnerships, communication is qualified as having a strategic role in universities, where it is seen as contributing to the distribution of information and knowledge to relevant stakeholders both internally and externally. One can think of public relations and marketing, matching of information sources to the public, the use of the internet and social media, and so forth. Communication, defined here in terms of 'sender, message, medium, and receiver, is regarded as one of the instruments for achieving change' (Leeuwis & Aarts, 2011, p. 6). Although I consider such a perspective as relevant and insightful, I am not interested in this kind of communication here. When referring to communication, I do not mean the diffusing or transferring of information and knowledge across organizations or individuals, but take a broader view that focuses on the everyday conversations in which mutual interdependencies between people are shaped and reshaped (Ford 1999; Leeuwis, & Aarts, 2011). In this view of communication, conversations between collaborating individuals and groups of individuals are the unit of analysis and are seen as ultimately determining the course of collaboration.

In developing and implementing complex interdisciplinary collaborative efforts within and across universities, actors with different backgrounds have to talk to one another to reach agreement on the way forward (Böhm, 1990; Isaacs, 1999). For example, scientists with different disciplinary affiliations have to talk about how to translate institutional priorities and develop common initiatives, how to pool different kinds of knowledge and technical expertise, and how to coordinate and manage operational issues. In each case, they achieve many of the outcomes to which they are committed by talking to one another (Ford, 1999). As Isaacs (1999) notes, 'In the new knowledge-based, networked economy, the ability to talk and think together is a vital source of competitive advantage and organizational effectiveness' (p. 11). From the perspective of this thesis, the conversations between multiple collaborating actors with different backgrounds, values, and interests need to be described and interpreted, offering a window into the dynamic and complex reality through which interdisciplinary is attained.

Problem statement

Much has been written about conversations for collaboration (Böhm, 1990; Isaacs, 1999; Pearce and Littlejohn, 1997; Scharmer, 2009), making clear that conversations are powerful mechanisms through which change comes about (Ford, 1999), but we know little about the mechanisms that shape the course of these conversations (Aarts, 2015). Studies that consider the process of collaboration pay attention above all to spoken conversation, usually focusing on the constant exchange of ideas and information through talk (Jeffrey, 2003). However, with our initial focus on spoken words, we tend to forget that conversations consist not only of what is said, but also of what is not said. Admittedly, scientists talk about many things when collaborating, but, like people functioning in other contexts (Morrison & Milliken, 200), they may for a variety of reasons decide to keep certain things off the table. Despite the fact that this has been observed in several studies in a variety of scientific settings (Hilgartner, 2012; Mellor & Webster, 2016; Vermeir & Margócsy, 2012), silence has not been examined as significant in the course of interdisciplinary collaboration in which scientists are working towards common goals and objectives. This glaring absence provides an initial impetus for this research.

The significance of silence as a research topic in studies on interdisciplinary collaboration, moreover, takes on heightened significance when we consider that silence is typically not expected to occur in a scientific context. Science is premised on the drawing out of verbal interactions. Debates on the social dimension of science highlight that open exchanges benefit scientific practice (Mellor, 2017; Resnik, 2006). Science requires information to be accessible to all interested parties (Munthe & Welin, 1996); this in turn depends on the free exchange of information and knowledge. This openness prevents science from becoming dogmatic, uncritical, and biased (Resnik, 2006). Restricting the open flow of information decreases the capacity to explore new information and impedes the duplication of scientific efforts, and error is not corrected (Bok, 1989). In the scientific community, the idea that scientific information should be freely accessible to interested parties is therefore strongly supported (Munthe & Welin, 1996). One would perhaps expect silence to play an even less significant role in interdisciplinary research collaboration, which rests on the assumption that open channels of communication are a precondition for accomplishing common goals. Collaborating parties are expected to engage in maximum participation and transparency, collating all the relevant evidence, putting it on the table, and discussing it openly. Characteristics of interdisciplinary research that have been identified are willingness to learn, clarifying differences, being open to diversity, and free and open exchanges of idea and information (Klein, 1990).

Given the overlooked role of silence in research on interdisciplinary collaboration, and the specific institutional context in which this research takes place, in which maximizing transparency and participation are important values, it is my aim to examine the significance of silence for interdisciplinary collaboration. From the perspective of this thesis, silence is regarded as indispensable for gaining more understanding about the course of interdisciplinary conversations; by failing to acknowledge these silences within the functioning of collaboration, we overlook a significant aspect of what collaboration is about. This responds to Jaworski's (2005) call to examine silence in institutional settings where discussion is thought of as the prototypical activity that proscribes anything but a constant, uninterrupted flow of talk. According to Jaworksi, such research can provide new and interesting avenues for studying interaction in institutional settings that need to be described, interpreted, and explained. Given Jaworksi's observation, the overall objective of this thesis is therefore to explore the role of silence in interdis-

ciplinary collaboration encouraged by universities trying to connect research and education around relevant societal challenges.

Research setting: the Delft University of Technology

To explore the role of silence, an ethnographic study was undertaken of interdisciplinary collaboration at the Delft University of Technology (TU Delft). The TU Delft is broad-based university of technology with a global reach, comprising the full range of engineering sciences, consisting of eight faculties offering 14 bachelor programmes and more than 30 master programmes. Currently, the university is immersed in a competitive national and international playing field that requires the (re)positioning of its research and education in relation to relevant societal and engineering challenges. Over the years, problem-driven, thematic interdisciplinary collaboration has become a focal point of the university's policy, which is given explicit priority in strategic plans and documents and concrete shape in various initiatives that seek to develop and leverage integrated, interdisciplinary approaches and networks within and beyond the university around today's relevant social problems (Delft University of Technology, 2016).

This thesis presents three case that describe and analyse the role of silence in real-life interdisciplinary collaboration undertaken at the TU Delft: 1) an intra-university collaboration to break down disciplinary and faculty silos in the area of water management, including a wide variety of scientists and engineers from disciplines and faculties, ranging from fundamental to utility-driven approaches; 2) an inter-university effort between the TU Delft and two large medical university centres in the same region to develop an innovative education programme at the interface of health and technology, requiring scientists and engineers to work in close collaboration with medical scientists and practitioners; and 3) and an international initiative involving the TU Delft and South China University of Technology (SCUT), which looks to bring together large groups of Dutch and Chinese architects, policy scientists, and engineers within the framework of a Sino-Dutch research centre in the area of green cities.

In the following sections, I discuss the various dimensions relevant to this thesis, starting with the notion of interdisciplinary collaboration, discussing policies and interactional approaches. Next, I look at the importance of conversation

for collaboration and explain how the concept of silence broadens the horizon of work on this topic. After outlining my research approach, I end this chapter with an overview of the thesis.

Conceptual framework

Interdisciplinary collaboration: between ideals and reality

A key concept in this thesis that needs to be explained is that of interdisciplinary collaboration. Science is an inherently collaborative enterprise (Finholt, 2003). Scientists collaborate in just about every domain of their academic work, to carry out research tasks, create joint publications, share scientific knowledge, develop new research plans and grants, and so on. In line with Hackett, I consider collaboration as a 'purposeful working relationship between two or more people, groups, or organizations. Collaborations form to share expertise, credibility, material and technical resources, symbolic and social capital' (Hackett, 2005, p. 671). Over the past decades, collaboration has taken on a decisively interdisciplinary character. Klein and Newell (1998) defines interdisciplinarity as 'a process of answering a question, solving a problem, or addressing a topic that is too broad or complex to be dealt with adequately by a single discipline or profession' (p. 393). This integration of problems can involve collaboration between two or more disciplines around a shared problem (Sonnenwald, 2007), across universities, at both national and international level (Katz & Martin, 1997), and with other stakeholders from society such as social organizations and businesses.

Over the years, there has been a sharp increase in interdisciplinary types of collaboration (Hicks & Katz, 1996), which are progressively problem oriented and guided by specific policy issues and problems. The current emphasis on inter-

disciplinary knowledge results in a change not only in the working processes of researchers, but also in institutions in which their activities are embedded and employed (Holley, 2009). Recent studies point to the widespread acceptance of interdisciplinary collaboration as an institutional imperative or strategy (Sa, 2007; Feller, 2006).

Particularly pronounced, in recent years, is the active role that universities fulfil in preventing overspecialization and knowledge fragmentation (Sa, 2007), orchestrating change and innovation, and providing strategic policy directions for the integration of research and education. Sa (2007) notes that has resulted in new interdisciplinary units, campus-wide institutes, and research centres and institutes. For example, in the Netherlands, research and education at the TU Delft is increasingly being connected to application-driven, thematic, interdisciplinary issues and questions. Therefore, the university has established the Delft Research Based Initiatives (DRIs), which encourage collaboration at both the research and the curriculum level to tackle societal and engineering challenges in the fields of health, energy, globalization, and infrastructures and mobility, by facilitating network and coalition building with parties and stakeholders both within and beyond the university. The DRIs are an example of the current prominence given by universities to strategically spurring boundary-crossing interdisciplinary research and education collaboration [Delft University of Technology, 2016].

Deliberate efforts by universities to pursue collaboration have attracted considerable interest from scholars seeking to understand and describe the external pressures, incentives, and organizational strategies that contribute to the growth in interdisciplinary institutional activity. First of all, institutional approaches are described as triggered by a combination of external pressures, such as growing scientific competition, internationalization of science, pressure from outside stakeholders and grant agencies to be accountable for research and teaching, depletion of resources and materials, and so on. In addition to external pressures, universities enter into collaborative agreements to achieve their own goals. Many incentives for university collaboration are cited, such as the transfer of people and ideas, the acceleration of economic growth, and improving ranking and profile. Studies also describe a great number of organizational strategies to facilitate interdisciplinary pursuits, including developing steering structures consistent with the promotion of interdisciplinary goals, specific types of interdisciplinary leadership, models for faculty support, how to build commitment within the faculty,

and central funding through the provision of incentive grants (see Feller, 2006; Liefner, 2003; Rhoades, 2002; Sa, 2007; Thorp & Goldstein, 2010).

From these policy and administration studies, we can see why stimulating these strategic types of interdisciplinary collaboration is becoming an imperative for universities. These studies provide valuable knowledge for managers and policy advisors looking to develop relevant institutional approaches to tackle today's social challenges. However, in their focus on macro level development, they lack a detailed examination of the actual experience of researchers (Sa, 2007) and do not offer much insight into the course of interdisciplinary collaborative processes (Thomson & Perry, 2006). Understanding these everyday experiences of collaborators is crucial for facilitating constructive interdisciplinary collaboration efforts. As Thomson and Perry (2006) note, before interdisciplinary collaboration can be adequately managed, we need to know how it is actually 'done'. This thesis seeks to reveal the everyday aspects of the process of collaboration; this involves shifting our lens from the macro level towards a micro level that considers interacting individuals.

Studying the micro-interactional dynamics of collaboration: paradoxes and tensions

To study the complex nature of interdisciplinary collaboration, I adopt a micro-interactional dynamics approach (Aarts, 2015). This approach starts from the recognition that collaboration takes place in everyday practice between a multitude of actors with different knowledge, interests, values, and cultural backgrounds, and shapes meaningful change in social structures, institutions, and wider phenomena at macro level (Leeuwis & Aarts, 2011). Despite there being many studies that emphasize the relevance of studying the micro dynamics of collaboration, the mechanisms that shape the course of these processes have not been subject to detailed interrogation and remain a 'black box' (Gray, 1989; Thomson & Perry, 2006).

Given this observation, I consider a focus on the paradoxes and tensions that arise during collaboration as insightful for understanding how collaboration progresses. During the process of collaboration, different interests, knowledge, values, cultural backgrounds, and perceptions constantly have to be aligned and

integrated, making it likely that tensions and paradoxes will arise. In the scientific collaboration literature, tensions and paradoxes are an enduring research topic, referring to the contradictory forces that tug at the collaborating participants (Hackett, 2005). Research collaboration scholars have examined how collaborators resolve and reconcile interactional challenges, a process that Turner, Benessaiah, Warren, and Iwaniec (2015) argue involves complex trade-offs that constitute 'essential tensions, paradoxes in the scientific process that evade clear-cut solutions' (p. 649).

Hackett (2005) has identified essential tensions in laboratory research collaboration. According to Hackett (2005), 'Tensions and paradoxes are essential features of collaboration, even within established, co-located research groups, so the mere occurrence of face-to-face interaction does not ensure that understanding and solidarity will result' (p. 668). Laboratory work immerses individual researchers in situations in which they have to fulfil different and conflicting roles. They are at the same time autonomous scholars and laboratory team members, and must navigate these contradictions and inconsistencies in face-to-face situations to achieve knowledge production. For example, early-career investigators may form '"para-collaborative" relationships that involved a sort of working alongside one another that offered many of the benefits of collaboration with no need to share credit or entangle identities' (Hackett, 2005, p. 792). In this way, interdependence and dependence are balanced.

Extending this perspective, scholars explain that interdisciplinary collaboration creates its own set of tensions and can lead to what Anderson (2012) describes as the 'intensification of previously identified essential tensions through the introduction of epistemic diversity' (p. 7). Similarly, Turner et al. (2015) write that interdisciplinary endeavours add a layer of tension to the collaborative process: 'These additional tensions are born from the inherent duality between the traditional role of the discipline—to unify and refine a set of theories, methods, and approaches to knowledge generation—and interdisciplinary collaboration, which depends on the interactions between a multiplicity of knowledge domains' (p. 649). In their study of an internationally renowned interdisciplinary environment–society research centre, Turner et al. (2015) demonstrate that 'the ways directors, administrators, and other leaders navigate these challenges shape the direction and fate of their interdisciplinary organization' (p. 649). From this perspective, tensions foreground the dynamic process of achieving collaboration in ongoing

interactions. As Hackett (2005) notes, essential tensions have descriptive and analytic value, they are an intrinsic and inseparable part of the collaboration process itself, allowing us to define, and reflect on, how collaboration is actually achieved.

On the basis of the previous literature, I consider interdisciplinary collaboration as an ongoing process where actors constantly have to align and negotiate differences (Leeuwis & Aarts, 2011). I use a focus on tensions and paradoxes that occur in these processes as the entry point for understanding the direction in which people shape these processes. By studying how collaborators navigate these interactional tensions, I aim to bring the emergent character of these processes into view, revealing how the choices people make determine the course of collaboration. In the next section, I further unpack the notion of interdisciplinary collaboration by discussing the conversationally constructed nature of collaboration.

Conversation for collaboration

A better grasp of the everyday complexity of interdisciplinary collaboration requires an understanding of how different individuals and groups of individuals talk about competing perspectives, values, and interests in different interactional contexts and settings. The literatures – both inside and outside traditional interdisciplinary scientific research – show that the role of conversation in collaboration is still not well understood (Aarts, 2015).

In the communication sciences, conversations are traditionally seen from a mechanical perspective, focusing on the mental processes of individual senders and receivers. Conversations are viewed here as a medium, transferring messages and information from one party to another. Although this view is pervasive in the communication literature, scholars adopting a construction model have argued that conversations are instead productive mechanisms through wWWWhich people construct meanings in interaction (Aarts & van Woerkum, 2008; Leeuwis & Aarts, 2011). In this approach, conversations are seen as part of the webs of historically grown relationships and interdependencies between people who are interacting within specific configurations of interests. Within these configurations, actors engage in different conversational practices, constructing meanings to achieve certain ends such motivating others to do certain things or regulating their appearances (Goffman, 1969). As a result, conversations are never neutral;

they have direct consequences for the social world (Leeuwis & Aarts, 2011). In the next section, I further discuss the notion of conversation, showing how difficult social issues are constituted in talk and how this can shape the course of collaboration.

Conversations and change

Conversations are the smallest unit of communication. At the most basic level, Ford (1999) notes that conversations can be considered to involve what is said and listened to between people. They are also the main medium of human interaction (Baker, 2010), providing ways for understanding experiences, creating interpersonal relationships, and building social institutions (Pearce & Littlejohn, 1997).

Despite their relevance, conversations are often taken for granted, as a background to what are considered more important activities. Shaw (2002) observes that 'we focus on the tangible products of conversation – the organizational designs, performance profiles, business models, strategic frameworks, action plans, lists and categories with which we seek to grasp the reified complexities of organizational life and render them "manageable"' (p. 10). In contrast, Shaw starts from the assumption that conversation itself is the key process that dynamically sustains and changes forms of organizing (van Herzele & Aarts, 2013). Conversations are powerful vehicles through which change comes about (Bohm, 1990; Isaacs, 1999; Pearce & Littlejohn, 1997). In talking to one another, people accelerate, slow, or alter the course of change in organizations (Ford, 1999). This makes conversations a key mechanism available for effecting change. Bate (2004) notes that, 'If you want to change the way people think, you should change the way they talk' (p. 261).

Scholars in the fields of management and conflict resolution have stressed the virtues of enabling constructive conversation (Pearce & Pearce, 2003), revealing how, in talking, people can transcend differences, uncover basic assumptions, compare incommensurate differences, and build strong interpersonal relationships. Isaacs (1999) argues that conversations have the capacity to 'bring out people's untapped wisdom and collective insight' (p. 2). He explains that conversations, in which people speak with their true voice and encourage others to do the same, have the power to make them learn to think together. Among other things, this involves the skills of listening, respecting, and suspending certainties. For

Isaacs (1999), conversing rather than telling is the 'glue that holds things together' in a competitive world where traditional hierarchies have eroded (p. 2).

Similarly, Pearce and Little-John (1997) identify conversations as mechanisms to bring to the surface underlying beliefs that have not been revealed. In what they call transformative conversation, people come to understand what they are doing, causing a perception shift that allows people to connect to one another. Thus, conversation is the main channel through which people 'establish a sense of self and other, to define the boundary between "us" and "them", and to create some sort of orientation toward others' (Pearce & Little-John, p. 108). From this perspective, collaboration is seen as constructed within conversationally constructed realties (Ford, 1999).

Difficult conversations

Productive conversations are a crucial component of interdisciplinary collaboration processes. However, much of our everyday talk does not provide solutions to the problems that we set out to solve. Leeuwis and Aarts (2011) clarify that 'communication is not something that necessarily brings people closer together or aids in problem-solving, but it can also add to incomprehension and the creation and reproduction of problems and conflicts' (p. 25). Recent research reveals that conversations are not always productive and do not necessarily unlock constructive change (Ford, 1999; Van Herzele & Aarts, 2013). Especially in high-pressure situations, conversations may fail to produce the desired results. As Patterson, Grenny, McMillan, and Switzler (2012) note, 'When conversations matter the most—that is, when conversations move from casual to crucial—we're generally on our worst behaviour' (p. 4). When people talk about complex and conflictual issues, conversations often resemble microscopic billiard balls zooming past one another and sometimes colliding at high speeds (Isaacs, 1999). When they talk about differences, people lose focus, reinforce their positions or arguments, or lapse into monologues (Aarts, 2015), reducing the potential to solve common problems. Conversations consequently bring people further away from developing new insights or shared interpretations of situations.

A number of in-depth case studies reveal how conversations lead to deadlocks in interaction. In his work on organizational leadership, Argyris (1994) has demonstrated how face-to-face conversational routines block learning and prevent knowledge creation; and van Herzele and Aarts (2013) describe how conver-

sations of forest owners in Flanders' governmental intervention played a role in developing and reinforcing their common point of view, increasing the distance between their and the government's point of view. These studies demonstrate that conversations can easily lead to impasses and conflicts, and increase polarization between opponents.

In line with these studies, I view interdisciplinary collaborations as conversationally constructed realties (Ford, 1999). In studying conversational construction, most researchers focus on what is spoken (for example, speech texts, speech styles, frames, the role of storytelling and metaphor, and so forth). However, conversations also consist of things we do not say, and are silent about. Now, I will discuss silence and how it offers a new vantage point from which to understand the course of collaboration in complex, interdisciplinary settings.

The role of silence in conversations

The aim here is to discuss some of the studies that mention the role of silence in scientific processes, but it is worth first briefly considering what is meant by silence more generally. Silence usually refers to the absence of sound or talk. Although it is common to think of silence as something that is missing from, or outside, discourse, scholars who have studied silence argue that saying nothing is an essential part of communication, showing how it complements speech in many ways (Jaworski, 1993). Blackman and Sadler-Smith (2009) write: 'Any assumption that if there is nothing being said there is nothing to be said may be fallacious' (p. 581); in fact, by ignoring silence, scholars overlook its capacity to indirectly shape social processes, because, as Sifianou (1999) mentions, like the zero in mathematics, silence has meaning as an absence with function.

Silence has many forms and can appear in different interpretative guises (Jaworski, 1993). Examples are the withholding of speech at a communicative event (Nakane, 2007), a break in a conversation marked by a hesitation or pause, the manner of addressing an issue (Gendron, 2009) or the communication of propositional content (Ephratt, 2008), or the failure to say what may be expected (Jaworski, 1989). These forms of silence are described in armed and violent political conflict, in worship and ritual, in the realm of remembrance and forgetting (Winter, 2009), in families or relationships (Wajnryb, 2001), and many more social

settings. Silence is furthermore studied in all sorts of organizational processes, amongst others large commercial firms, hospitals and medical centres, and the police force. In these settings, these scholars note, silence fulfils a range of functions in interaction, where it for instance allows speakers to organize their thoughts, conceal their opinions and feelings, communicate potential meanings, manage and display emotions, mark interpersonal distance, negotiating power, and so on (for overviews of the functions of silence, see Jaworski, Johannesen, 1974; 1993; Krieger, 2001; Nakane, 2007).

Building on the previously mentioned studies, I explore silence as a crucial part of interdisciplinary conversations, examining the functions that it serves in the way collaborators talk to one another. Because silence has almost as many functions as speech (Nakane, 2007), I do not define the notion of silence too tightly and instead use the empirical material to explore which specific functions of silence are important for interdisciplinary work. Before explaining my approach in more detail and outlining the research questions, I review some of the aforementioned functions of silence that are apparent in scientific activities and interactions more generally.

Functions of silence in scientific settings

Secrecy scholars have paid particular attention to the role of silence in sharing by purpose. In a landmark work on the topic of secrets, Bok (1999) explains that, although silence and secrecy in science are often condemned publicly, the academic freedom to share information is sometimes curtailed, for instance when knowledge is seen as jeopardizing public security. When this happens, silence is 'the first defence of secrets' (Bok, 1999, p. 7), guarding the limits of what can be talked about freely and how knowledge is made public. For example, scientists working in strict scientific regimes may be instructed not to talk about their work to keep others from perceiving development and progress, for instance for the sake of national security (Rappert, 2007). An insightful example is the Manhattan Project, which was developed under a policy of strict compartmentalization, in which information about the project was circulated on a need-to-know basis managed through a classification system (Mellor & Webster, 2016). Scientists were sometimes encouraged, and sometimes forbidden, to talk about the project to colleagues. To prevent information about nuclear research being leaked to the enemy, letters were censored, access to sites restricted, and media outlets curtailed (Den-

nis, 1999). In other words, silence can be imposed on others and mandated to protect scientific breakthroughs and secure the progress of research.

Limits of information exchange

Silence is furthermore used to limit the strategic exchange of information during interaction between scientists. Hilgartner (2012), in his study of the genome research community, describes how scientists seek to control the flow of scientific knowledge in their interactions with colleagues. The genome scientists in his research artfully shifted between releasing certain information while withholding other information about matters such as data access, ownership, and control. They considered certain kinds of information, such as unpublished findings of research on gel mathematics, as shareable, whereas other kinds were considered as being in the category 'loose lips sink ships' (Hilgartner, 2012, p. 11).

Likewise, in her study of patentability in an academic context, Biagioli (2012) points to the role of silence in protecting scientific data and discoveries. Making an invention public in a competitive culture where novelty and originality prevail can reduce the chances of securing a patent. Biagioli (2012) explains that, even though researchers and investors value publication for the specification of inventive ideas, they may choose temporarily not to disclose information to safeguard intellectual property rights of inventions through patents. In this research arena, silence becomes a way of giving space to time and maximizing the invention's value within such a system. The importance of non-disclosure practices extends to contemporary laboratories and research groups that deliberately refrain from disclosing their results. Evans (2009) notes that: 'Competition creates paranoia over being scooped or beaten to publication by others, sometimes with one's own disclosed data' (p. 785). The result of this is that scientists communicate ideas and results selectively and try to publish completed findings first. In sum, then, silence involves selectively making knowledge or information available to others (Mellor & Webster, 2016).

Construction of identity

Silence is not used merely to protect research findings or protect discoveries; it is also linked to the establishment of confidence and trust, and the construction of identity. Vermeir and Margócsy (2012) show how a tight community benefits from silencing specific information. Not sharing certain information with specific peo-

ple, such as inferiors or competing researchers, can morally and psychologically bind those who keep quiet, laying the foundation for a strong sense of academic identity. Several scholars have pointed out how restricting certain ways of knowing anchors the authority necessary for social groups to communicate scientific knowledge or advice in an effective and reliable way (Frissen, 2016; Gusterson, 1998).

For example, in their study of the Dutch Health Council – the highest advisory body on health issues in the Netherlands – Bijker et al. (2009) reveal the vital significance of selectively informing parties in the production of scientific advice and the maintenance of authority and expertise. To secure the authority and legitimacy of scientific advice, the advisory body had to shift between the backstage – where advice is discussed freely between committee members – and the front stage – where the disclosure of certain information is curtailed: 'while science tends to show its poker face when operating on society's frontage, its other faces – expressing doubt, hesitation, and bewilderment – tend to become visible as soon as one starts looking more carefully at what goes on backstage (where scientific knowledge is actually produced)' (Bijker et al., 2009, p. 32).

Construction of ignorance

Furthermore, scholars point to the strategic function of silence in science, demonstrating how it works in the active suppression of knowledge and the construction of ignorance in scientific practice through denial and the distortion of scientific evidence and manipulation of public debates (Croissant, 2014; Geissler, 2013). In particular, the growing field of ignorance studies addresses the normative assumption that science rests on certainty, illustrating that scientific organizations construct doubt and uncertainty. Ignorance studies are occupied with understanding how people or organizations keep themselves from knowing through tactics such as denial, ignoring, and avoidance (Oreskes & Conway, 2010; Proctor & Schiebinger, 2008).

This type of silence is observed in a variety of scientific settings. Proctor and Schiebinger (2008) describe how tobacco manufacturers aligned themselves with scientists, establishing scientific front organizations that studied and falsified the facts of tobacco cancer hazards. Publicizing their result in their own journals and magazines, commercial scientists opened up channels for alternatives to mainstream research, downplaying the hazards of smoking and silencing infor-

mation that harmed the cigarette industry. These collaborations between science and industry helped to create half a century of conspired silence about the health risks of smoking. Regarding the open exchange of scientists' ideas, Proctor and Schiebinger (2008) conclude: 'Science even in the best of circumstances is 'open' only under highly ritualized constraints' (p. 9).

The research gap

Existing studies of silence in scientific work thus acknowledge that information is not necessarily exchanged openly (Vermeir & Margócsy, 2012), showing that the production, development, and distribution of scientific knowledge depends on silence as well as on speech (Mellor & Webster, 2016). Despite the studies that recognize the significance of silence as part of scientific processes, the role of silence in the context of interdisciplinary collaboration, where actors are driven less by competition than by the attainment of common goals, has not been explored. As yet, there are no studies that explicitly examine silence in interdisciplinary conversations. Moreover, the existing work on silence suffers from a lack of detailed case studies. Research relies mainly on the researchers' point of view; empirical research that addresses the participants' perspective in assessing the significance of silence in interaction is lacking (Jaworksi, 1993). There is little basis, other than theoretical observations, from which to understand the role of silence in complex and dynamic interactional processes. A consequence of this lack of empirical work on silence is that a great variety of its interactional functions are mentioned, but the effects of these silences on the course of interaction are less often considered. Given the above, this research looks to empirically answer the question of what the functions and the effects of silence are in the interdisciplinary collaboration intended to connect universities around relevant societal problems. This question is addressed in the following three sub-questions:

1. What are the main functions of silence in interdisciplinary conversation?
2. What are the effects of these silences for the course of interdisciplinary conversation?
3. What are implications for university leaders and policy makers, scientists, and communication professionals participating in, and supporting, these interdisciplinary collaborations?

Methodological considerations

An ethnographic study of interdisciplinary collaboration

To examine silence in interdisciplinary interaction, a research perspective is needed that makes the everyday conversation in collaborative efforts insightful and tangible. There is a lot of knowledge available about interdisciplinary collaboration, as explained in the conceptual section, but the situated, real-life practices of working interdisciplinarily are less often discussed. As Shapin (2008) mentions in *The Scientific Life*, the practical texture of everyday life is often missing from accounts of late modern science: 'Late modern science is sometimes celebrated and sometimes condemned... [but] rarely described in much detail, especially with respect to the experiences of those who live within its opportunities and constraints' (p. 229).

To explore the everyday conversations that make up interdisciplinary work, an anthropological approach was adopted. Anthropologists study people's logics for acting and thinking in the way they do, and how this is reflected in their daily practices and activities. Anthropology is indeed a coat of many colours, but Bate (1994) distinguishes four key dimensions that set anthropological work apart from other kinds of research such as management sciences. First, anthropology gives attention to the historical contextualization of its subject, studying how the past shapes and moulds people's thinking and behaviour in the present, including their ways of forming society and organizing. Second, anthropology is contextual in

that thought and behaviour are understood within a specific, situated context. The interactions themselves and the context in which they take place are a central focus of concern. As Bate notes, individuals are observed in their daily activities, and accordingly placed back in the context in which their action takes place. Third, anthropology is processual: it does not view human relating as static and fixed, but as a dynamic process in which meanings are constructed and exchanged. Fourth, it is actor centred. This means that the reasons people themselves have for acting and communicating are explored, starting from the assumption that insights always come from within. Given my research aim of studying the conversational dynamics of interdisciplinary collaboration from a silence perspective, the anthropological framework allowed me to study the perspective of the scientists and the engineers themselves, including the broader processes through which their conversations are dynamically shaped and contextually situated.

The anthropological approach brings its own methodological toolkit to study human interaction. One of the pillars of anthropological research is its reliance on ethnography as a qualitatively oriented way of conducting research. Ethnographic research takes place in the everyday environment rather than in an artificially contrived environment and depends on the researcher's immersion in the everyday practice of its participants. This means exploring how different groups interact and variously interpret situations, studying the topic from distinct perspectives by participating in these interactions for an extended period of time. Through this method of participation, the researcher comes to understand the subtleties and peculiarities of people's behaviour and its meanings.

Ethnographic research methods

Ethnography emphasizes the interpretive, constructivist, and reflective dimensions of the research process (Yanow, 2006). Within an ethnographic research method, it is not the predefined conceptual framework that tells the researcher what is relevant or not during research. As a scientific method, ethnography explores the nature of social phenomena, rather than setting out a hypothesis about them (Hammersley & Atkinson, 2007). Whereas the natural sciences rely on botanical metaphors that presuppose that data are brought back to the researcher's lab for analysis, ethnography holds that what we bring back from the field are representations and texts (Yanow, 2006). Fabian (2008), a leading anthropologist who helped redefine ethnography from a dialogical perspective,

explains that: 'Ethnography ... does not produce data, bits of information that are then fed into, and used up by, an analytical machinery; what we take away from the field are texts, documents, communicative events, of performances and conversations, texts which, moreover, are resilient in that they resist reduction to explanatory schemes' (p. 204). Thus, data are not analysed and tested against a predefined theoretical framework. They are interpreted and constructed through iteratively drawing inferences from observations, interviews, and other research material. This process is continued until those questions have been answered with the greatest emic validity possible. Hammersley and Atkinson (2007) describe the research design a as continual process rather than being fixed at the start and requires iteratively going back and forth between the collection and the analysis of data, which starts at the moment of outlining the research question and continues on during daily fieldwork and well into the process of writing up findings (see also Yanow, 2006).

This dynamic and explorative research approach was used to study conversations for interdisciplinary collaboration at the TU Delft. The data were collected in three separate case studies that were subsequently carried out over the course of two years (between 2012 and 2014). The cases investigated the networks of daily conversations (Ford, 1999) of those involved in developing and implementing interdisciplinary collaborative efforts. I observed a great number of interaction moments (strategy meetings, planning session, congresses and symposia, informal get-togethers, email exchanges) and interviewed many people about their experiences of these interactions. This allowed me to study how participants navigated the tensions and problems that they confronted in everyday practice by talking about them and remaining silent. Because the cases were undertaken over a relatively long period of time, and informants were contacted several times, it was possible to study the course of the interaction across a range of contexts. In total, I collected data from 99 interviews, 45 observation reports of meetings and other types of interaction such as informal gatherings and email exchanges, and numerous background and policy documents. Now, I will clarify the cases and why they were selected.

The role of silence in interdisciplinary collaboration: three case studies

As mentioned previously, my background is in anthropology. Lacking a background in the field of technology, I did not have sufficient knowledge of the particular engineering context in which the research was set. Therefore, I first undertook a pilot study to familiarize myself with the setting and the people, exploring a university-wide initiative to strengthen relationships with government by participating in the *Innovatie-Estafette* 2012 (innovation relay 2012). During this large-scale public relations event, governmental agencies, companies, and universities presented cutting-edge scientific and technical innovations. I also attended planning meetings of the university's committee, which involved several key scientists, engineers, and the university's supporting staff members, and conducted several in-depth interviews with key informants.

Besides introducing me to relevant informants for my further research, the pilot attuned me to the significance of silence. Although I did not set out to study silences, what struck me most during this initial process of collecting and analysing the data was that people often did not discuss seemingly important differences in perspective during meetings. Even though there was often an atmosphere of friendly camaraderie, and people seemed to agree with decisions, in interviews they expressed frustration with the process, mentioning that they felt other decisions were necessary, but were often uncomfortable articulating this in the presence of their partners. Pertinent issues were as a result postponed, often never to return to the discussion. Although the broader significance of silence was not immediately apparent to me, these instances triggered my interest in what was being left unsaid.

In the following case studies, I began to study the silences that made up many conversations more directly. The concept of silence was used here as a sensitizing concept (Blumer, 1969). Sensitizing concepts offer the researcher interpretative devices that give 'a general sense of reference and guidance in approaching empirical instances' (p. 7). As Charmaz (2003) writes: 'Sensitizing concepts offer ways of seeing, organizing, and understanding experience … Although sensitizing concepts may deepen perception, they provide starting points for building analysis, not ending points for evading it. Sensitizing concepts are points of departure from which to study the data' (p. 259). As a sensitizing concept, silence shaped

my study of interdisciplinary collaboration, suggesting directions along which to look (Blumer, 1969). It is thus useful to bear in mind that I did not start with preconceived notions of what silence was. The empirical material gave the lead. The successive case studies undertaken throughout the project informed and refined my understanding of the meaning of silence in the collaborative research context. Silence thus provided me with a place to start, not to end (Charmaz, 2003).

In the following sections, I describe the three cases that I undertook to examine the role of silence in interdisciplinary collaborations to strategically connect research and education at the TU Delft around today's social challenges, and I discuss the basis on which these cases were selected. Following the categorization offered by Katz and Martin (1997), my focus was on different levels and patterns of collaborative activity. These levels are between departments and faculties within the same institution (inter-departmental), between institutions within the same geographical region (inter-institutional), and between geographical regions and countries (trans-institutional).

Case 1: interdisciplinary collaboration in water management

The first case, undertaken in 2012–2013, examined an interdisciplinary collaboration between different disciplines and faculties within the university in the field of Dutch water management. Problems and issues in water management are constantly changing and require new and integrated solutions. The university has long been a key contributor in delivering water-related engineering knowledge and technology. To maintain its position as a frontrunner in the field and develop cutting-edge knowledge and technology to meet 21st century problems, university-wide collaboration was needed to break down the silo mentality within the university. The case examines the conversations between engineers, spatial planners, and social scientists from the TU Delft in their effort to build a common platform to make the university fit better in today's socio-technical trends. The case was particularly challenging because the conversations required me to transcend inward-looking discipline silos that had a history of enmity and competition, making it an effort full of tensions in which erstwhile opponents needed to bridge differences to reach agreement and develop a common course of action.

Case 2: the medical technology bachelor

The second case study explores a regional collaboration between the TU Delft, the Leiden University Medical Centre (LUMC), and the University Medical Centre Rotterdam (ERASMUS) to develop and implement a Medical Technology bachelor course. This course, situated at the interface of health and technology, is the first of its kind, covering a unique combination of academic disciplines (such as systems biology, anatomy, pato-physiology, the immune system, diagnostics, medical statistics) and technical principles (such as thermodynamics, electrical engineering, design mechanisms). The case fits into the broader context of the TU Delft's regional positioning through forging a strategic alliance with the LUMC and Erasmus, adding value by improving the institutions' quality of education and research as well as providing a test case for future integration. Realizing the programme meant that many actors at both the policy and the workflow level had to secure the commitment of a great number of stakeholders (university managers, professors and medical professionals, upper-level policy advisors, teachers, and external stakeholders), ensuring that everyone's perspectives and interests were represented.

Case 3: the Sino-Dutch research centre

The third case explored a large international collaboration between two universities. The case, which I carried out in 2013, explored the development South China University of Technology (SCUT)/TU Delft Research Centre. The collaboration is geared towards deepening Sino-Dutch academic relations. The centre's objective is to lay a firm foundation from which future problems in the urban area can be jointly tackled. The very prestigious centre fits with the larger ambition of the TU Delft to position its research and educational activities in China, enabling scientists to work there. The case explores the daunting task of collaborating in an unfamiliar scientific, national, and cultural environment, in which team members who had generally not worked together previously had to talk with people with very different communication styles and norms.

Selecting the cases

Although the impetus for starting these efforts varied, what connected them was their problem-driven and interdisciplinary character, and the fact that all efforts were connected to a broader strategic positioning process that should result in the construction of a common platform or outlook between previously independent parts of the university, making the university fit better in today's trend of interdisciplinary. These collaborations were all officially supported and funded by the university. They were initiated from the bottom up; this means that ideas that were already present in the university's objectives limited the freedom and creativity of the semi-democratic working groups that needed to discuss, elaborate, and implement the projects. 'The structure of collaborations is shaped by particular encumbrances or complexities imposed by these formative processes' (Shrum et al., 2007, p. 210). In these settings, the ability to control resources, justify the collaboration's existence, sell the vision to others and link participants around common goals, and manage potential conflicts of interests was more important than intellectual creativity for bringing together the collaboration (Shrum et al., 2007).

Collaborating on equal footing

Another point is that, in university-driven collaboration, loosely coordinated participants have to interact horizontally to pursue a common goal. Working interdependently and adaptively around a common problem is different from working in a traditional research group or team. In the latter, participation is usually defined by professional roles based on a shared common purpose. Collaborating partners have different levels of seniority (Hackett, 2005), and certain members can speak for and represent others. However, in horizontal collaborations, people must collaborate on an equal footing. To a great extent, they are one another's equals in status and position. Partnerships of equals, with comparable levels of authority and power, create interdependencies that are more difficult than partnership that are asymmetric, mostly because actors must represent one another's work and hold one another accountable. This creates reputational and status issues and problems, for instance because actors may not accept one another's authority on issues or perceive it as a threat to their professional identity. This can lead to what Blok (1998) has called the 'narcissism of minor differences', in which minor differences are experienced as more important than major ones, resulting in status anx-

iety, fierce competition, and conflict between parties. The efforts thus foreground questions of identity and rivalry for status and positioning.

Formality and centralisation

Another important aspect is the operational scope of these collaborations' projects. Explorative projects have a long time horizon and high profile status. Long-term protects are intellectually provocative but are not very likely to yield quick deliverables in terms of research funds, and participating in them is less attractive from a career advancement point of view (Sonnenwald, 2007; Stokles et al., 2008). Collaborators usually take part voluntarily, and this limits the time that they can, or are willing to, invest in accomplishing necessary tasks and operations (Shrum et al., 2007). Additionally, the heightened visibility and accountability of working in the spotlight enhances the chance of reputational damage and failure, and the risk of the undertaking (Katz & Martin, 1997, p. 16).

From the above, we can see that the collaborations examined in this thesis were difficult to initiate, required massive efforts from autonomous but interdependent participants that had to collaborate on an equal footing, and involved operational issues that could have career consequences. I consider this type of collaboration particularly interesting to look at from a conversational perspective, as participants needed to work towards a consensus of which the main characteristics were already determined from the start. This seems to be a situation full of tensions, in which all the participants need to manoeuver with a lot of caution and care, putting them in a position in which they have to engage in difficult conversations to reach this agreement – in other words, a situation where silence might play a relevant role.

Practical considerations for case selection

In addition to the theoretical considerations, practicalities played an important role in the selection of cases. According to Yanow (2014), determining cases is thought to presuppose a mechanistic logic of inquiry, suggesting that cases can be stipulated ahead and that the research will naturally follow this path. However, "different case setting will, ipso facto, generate differently situated meanings (although the meaning-making processes in different settings might be similar). Whether the differences will be great (most different) or small (most similar) cannot be determined a priori" (Yanow, 201). Research settings are dynamic and can-

not always be subject to researcher control (p. 149). For ethnographers, cases are not selected only on the basis of predefined selection criteria: questions of access, starting with choices of settings, actors, events, archives, and texts in which and among whom to pursue the research question, are also given considerable attention.

In this particular research, gaining access to the relevant meeting tables was a challenge. Before actual interactions could be studied, I had to find the right moment to establish contact and had to secure participants' trust and acceptance. This took a considerable amount of time, perseverance, and social adroitness. For example, initiatives that fitted my research proposal turned out to exist only on paper, making direct observation of conversations impossible because contact between actors either still had to be established, or projects were already in concluding stages, and there was no interaction to study. I also struggled with gaining trust and obtaining permission to attend and observe ongoing interaction. I was, for instance, denied access to a very interesting Particle Therapy Centre collaboration. At the time of research, building a Particle Therapy Centre on the campus of a technical university was a very sensitive issue in society, and those involved did not want a researcher prying around who could potentially jeopardize its realization. Doors were kept hermetically locked.

Given these research practicalities, the three cases were selected not only on the basis of the predetermined criteria, but also because they provided me with an opportunity to come as close as possible to everyday collaborative action. They allowed me to be present as much as possible at the occasions when actors were talking about complex issues and problems in interaction. Put differently, they provided me with feasible research settings, allowing me to study participants' experiences and perspectives.

Thesis outline

The rest of this thesis consists of four chapters, in three of which I present the case studies as they were researched, and a concluding chapter. The cases illuminate different aspects of silence in interdisciplinary conversations. Chapter 2 focuses on collaboration between faculties and disciplines within the university, bringing into view the silences in the conversations between engineers, spatial planners, and social scientists in the area of water management. The chapter places emphasis on the silences that occur when scientists from the same university come together to address external challenges, and apparent unanimity within the group is needed to shape a common initiative between heterogeneous actors. Chapter 3 broadens the scope of collaboration, concentrating on multi-stakeholder conversations aimed at developing and implementing an educational programme at the interface of health and technology. The chapter concentrates on the silences that arise when people try to navigate operational issues aimed at connecting multiple actors to an uncertain and highly fragmented innovation process. Given the importance ascribed to learning in other chapters, chapter 4 offers a theoretical interlude and reflects on the relationship between silence and social learning, describing how silence can enable and constrain collaborative learning processes in groups, teams, or networks. Chapter 5 presents a case study of international collaboration, concentrating on the meanings of silence and their interpretation in the intercultural conversations between Dutch and Chinese scientists in their efforts to develop and implement a joint Sino-Dutch research centre in the area of sustainable and green cities. Chapter 6 finally integrates the findings of the dif-

ferent cases, presenting four main functions and effects of silence, and discusses their relevance for optimizing collaboration and designing future studies.

02

SILENCE IN INTERDISCIPLINARY RESEARCH COLLABORATION: NOT EVERYTHING SAID IS RELEVANT, NOT EVERYTHING RELEVANT IS SAID

ABSTRACT

Solving publicly important issues asks for the development of socio-technical approaches, which demands collaboration between researchers with different perspectives, values, and interests. In these complex interdisciplinary collaborations, the course of communication is of utmost importance, including the moments when people, consciously or not, keep silent. In 2012, an interdisciplinary group of water management engineers and scientists collaborated to explore how the university's separate water management research fields could fit better in today's socio-technical trends. Studying the interactional process revealed that during the collaboration many issues were not said by various parties at various times. Results show that, in particular, engineers and scientists stayed silent to secure group performance, to keep disagreements from surfacing, and manage conflicts of interest in the bargaining process. Although silence served various interactional functions, it also shaped the course of interaction in ways that were not intended, resulting in the development of a latent conflict. It is concluded that the concept of silence adds a relevant dimension to our understanding of interaction among engineers and scientists participating in interdisciplinary collaboration that is currently absent in existing literature on scientific collaboration.

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Introduction

Solving today's publicly important issues such as electricity provision, transport infrastructures, medical care, and cyber security, requires the development of socio-technical approaches. This means that collaboration between researchers from different disciplines, as well as changes within universities that connect researchers within the institution around these challenges, must be encouraged (Gibbons, Limoges, Nowotny, Schwartzman, Scott & Trow, 1994; Simakova, 2012). In the light of these challenges, it becomes important to analyse and understand the process through which collaboration comes about in interaction.

Previous studies have deepened our insights into the workings of research collaborations, showing how they can ignite interdisciplinary work and solutions, but are also extremely demanding to accomplish in everyday practice (Hackett, 2005; Farrell, 2001; Shrum, Genuth, & Chompalov; Sonnenwald, 2007). Several studies argue that, under the veil of solidarity, there are enduring tensions in research collaboration, which can arise at various levels and phases, and have diverse causes and out- comes (Hackett, 2005).

These tensions are related to the discrepancy between the labour- and time-intensive character of interdisciplinary projects and their low priority in academic circles (Bukvova, 2010; Cummings & Kiesler, 2005; Stokols, Misra, Moser, Hall & Taylor, 2008). Other scholars have noted that tensions have to do with differences in disciplinary orientation, motivations and professional interests (Shrum et al., 2007; Sonnenwald, 2007). For example, working on interdisciplinary research projects requires the integration of research into innovative projects and working

towards a shared identity, whereas disciplinary obligations require the guarding of existing disciplinary fields of inquiry that took years to develop (Hackett, 2005).

Given these challenges, the ability to constructively communicate is seen as a precondition for resolving many of these tensions (Bukvova, 2010; Jeffrey, 2003). Scholars of scientific collaboration, as well as those studying collaboration in closely related domains (Lewis, Isbell & Koschmann, 2010; Pearce & Littlejohn, 1997; Wenger, 2000; van Oortmerssen, van Woerkum & Aarts, 2014) have pointed out that constructive communication can help to clarify roles and task requirements, increases trust and psychological safety, resolves disagreement and conflicts, and contributes to developing new frameworks for solving problems (Jeffrey, 2003; Stokols et al., 2008).

Salient issues, however, do not necessarily make it to the meeting table. Under certain conditions, scientists may choose to temporarily stay silent about tension-filled incidents or perceived differences in interaction with their peers, or may never bring them up at all. As of yet, the meaning of silence in interaction has not been identified as a key component of academic collaboration. This article addresses this glaring absence in the literature and explores silence in the context of interdisciplinary collaboration aimed at accomplishing institutional policy designed to fulfil social responsibilities.

We build on earlier studies that have highlighted the importance of understanding silence in other interactional contexts. We specifically respond to Jaworski's (2005) call to examine the significance of silence in institutional contexts such as criminal justice systems, classrooms, or hospitals, where communication is generally thought of as a prototypical activity. Jaworski also notes that, in these con- texts, silence is often more important than initially thought and has unforeseen consequences for people's willingness to achieve stated institutional goals. Following this line of inquiry, this article poses three questions:

1. Which specific functions of silence can be identified within interdisciplinary research collaboration aimed at developing socio-technical approaches to solve today's public issues?
2. What are the unforeseen consequences of these silences for course of the collaboration process?
3. What are the practical implications for overcoming such silences and thereby avoiding their consequences?

These questions take on heightened importance because of the international competitive research context in which communication has become crucial in igniting and supporting the overall strategic orientation of universities (van der Sanden & Ossewijer, 2011).

To guide our research question, we begin with a review of existing studies of silence in social interaction. Drawing on these studies we then discuss the significance of silence in a university-wide research collaboration between scientists from various disciplines and faculties geared towards developing socio-technical approaches to public problems in the area of water management. The findings are based on empirical work undertaken during an ethnographic case study examining the effect of moments of silence on the course of interaction between the water management researchers in the process of consolidating the leading position of their parent university. After outlining the findings, we end with a discussion on the practical implications for overcoming silence and facilitating constructive conversations in interdisciplinary collaboration.

Conceptual overview: silence in social interaction

Silence is a complex concept that can be explained in many different ways. Just like verbal communication, it has significance at different levels of interaction between actors. It can mean consent, but can equally signify doubt, defensiveness or even resistance, depending on the interactional context. In well-facilitated collaboration, silence may have a positive virtue, being a moment of reflection that allows for clarification of motives or consideration of alternative possibilities for oneself and alternative interpretations of what others are doing (or not) (Schuman, 2006).

Many interdisciplinary collaborations, however, come about in a messier manner. Hence, in this article we focus on silence as the absence of any type of verbal communication in collaborative interaction where that communication would normally be expected to enable coordination, collective action, and planning and time management. Consequently, we assume that silence serves interactional functions when perceived through the eyes of the involved researchers, but can also have unforeseen consequences for achieving shared goals (Jaworski, 1993; Krieger, 2001). These functions and unforeseen consequences of silence are examined in relation to three overlapping levels of collaborative interaction: (1) securing group performance; (2) dealing with relationships within the group; and (3) managing conflicts of interest.

These dimensions are often distinguished and studied in the collaboration literature (e.g. van Oortmerssen et al., 2014). The first dimension refers to the consensus-seeking interactional process that takes place in relation to relevant outside constituencies and demands. The second dimension refers to the pro-

cesses internal to the group. The third dimension refers to the way group members manage and solve conflicts that emerge in interaction as a result of colliding interests. In the next section, we discuss these three crucial dimensions of collaboration in relation to silence.

Silence and securing group performance

In relation to securing group performance, scholars frequently focus on how actors use verbal communication to deal with the demands of organizational work, revealing how it relates to coordination and collective action, planning, and time management. In addition to verbal communication, silence is also relevant. As Goffman (1969) noted, members within a group are likely to attune their behaviour towards one another and prevent contradictions. When working in projects, he wrote, 'each participant is expected to suppress his immediate heartfelt feelings, conveying a view of the situation which he feels the others will be able to find at least temporarily acceptable' (Goffman, 1969). In interaction, participants give lip service to matters raised by others, allowing everybody to raise ideas and opinions in exchange for the courtesy that others do not contradict or criticize what they have to say on the issue (p. 4).

Bringing the theory of Goffman (1969) to the field of science and technology, Hilgartner (2000) demonstrates how selectively presenting some things in public while hiding others backstage, plays a key role in the process by which scientific advisory bodies produce, contest, and maintain scientific advice. Hilgartner's work illustrates how the credibility of science consists of strategic impression management by team members and deliberate control over what is said and what is not. Further studies have shown how concealing disagreements keeps research teams from splintering into competing groups. In her empirical study of a scientific team that develops land remediation for coal waste disposal sites, Castaán Broto (2011) illustrates how emphasizing mutual dependence rather than differences plays an important role in incorporating the concerns of diverse team members and constructing a common front.

Moreover, participants are most likely to stay silent about dissension within the group when they face demanding external situations that put pressure on the group, or when they have to operate under significant time constraints. At the

beginning of new projects, group members still have to align their behaviour to come to terms with the demands of external stakeholders. Interaction is still relatively uncertain and prone to bargaining of all kinds (Bok, 1989). Ideas and strategies still have to be developed. The pressure created by external threats makes it all the more likely that group members will keep silent about certain ideas or aspects of emerging plans within inter-professional interaction. Especially when people have to achieve things fast, they may feel the need to get on with the task and will postpone certain discussions (Perlow & Repenning, 2009).

Although silence makes interaction smoother and helps team members manage the achievement of a shared objective (Castaán Broto, 2011), it can have unforeseen consequences for the nature and course of interaction, for example causing that unjustified assumptions and beliefs are not critically examined and discussed. When silence keeps group members from sufficiently sharing and debating their plans with relevant stakeholders in the group, this shuts out criticism and feedback and prevents the exploration and articulation of potential differences (Bok, 1989). Especially under time pressure, people may revert to established routines that proved successful in the past. They start relying on shortcuts and quick fixes to solve complex problems that instead require discussion and debate (Dörner, 1996; Henriksen & Dayton, 2006).

Silence and dealing with internal relationships

Silence does not only emerge as a result of reaching an internal consensus because of high external stress. Relationships internal to the group can also provide a stimulus for members to stay silent about certain problems or issues. When group members have to interact, interpersonal exchanges can give rise to problematic or even threatening situations. In these situations, staying silent is often preferred over talking about them.

Argyris (1980) has shown that highly skilled professionals are prone to use silence to protect themselves when threatened by the prospect of having to critically examine their own role in the organization. They do this because they fear embarrassing, and being embarrassed by, others. Silence is not only used to avoid risky talk and conversation that would affect their position, status or image. Saying nothing about precarious issues or problems can also reflect cooperative motives

such as not wanting to damage colleagues or future partners (van Dyne, Ang & Botero, 2003).

Morrison and Milliken (2000) describe embedding silence in wider organizational routines and processes as a collective organizational phenomenon that results from not wanting to damage relationships and lose relational currency that can lead to career advancement. They assert that individual-level silence reflects wider concerns about protecting one's social capital, which employees need in order to perform their job effectively. Employees who address salient issues are, for example, perceived as troublemakers, and this can lead to their exclusion from social networks and compromise organizational performance.

Perlow and Repenning (2009) also argue that individual employees do not fully express themselves when they perceive differences. In their study of a Silicon Valley Internet company, they show how the company's founders and managers fail to discuss interpersonal relationships because they are concerned that it might damage their relationship and ultimately the success of their company.

Although silence is used to protect professional identities and sustain relationships, an unforeseen consequence may be that it damages these same relationships in the long term. In addition to the personal costs associated with silence such as stress, dissatisfaction and cynicism, scholars have pointed to its disintegrative effect on group and organizational processes like jeopardizing cooperation and organizational buy-in (Morrison & Milliken, 2000). Perlow and Repenning (2009) explain that when the fear of damaging the relationship increases, initial acts of silence lead to more pressure to keep silent in the future. This results in a downward spiral that increases silence and corrodes the relationships on which organizational performance depends.

Silence and managing conflicts of interest

Silence is also used to manage conflicts that arise in organizations. Most conflict resolution models suggest that conflict management involves reaching a mutually acceptable solution through engaging in open and verbal exchange and confrontation. However, not all conflicts attract public attention. Conflicts are often a perennial feature of organizations. They are 'present in the crevices and crannies and just below the surface, bubbling up occasionally as disputes in certain places

and enacted in accord with particular conversions and rules' (Kolb & Bartunek, 1992, p. 10). Silence contributes in keeping conflicts implicit.

Arguing from a negotiated order approach, Strauss (1978) explains that when two members have a vested interest in resolving conflict they may resort to silent bargaining rather than talking about the issues. Strauss wrote that:

> Some negotiations may be very brief, made without any verbal exchange or obvious gestural manifestations; nevertheless, the parties may be perfectly aware of 'what they are doing'—they may not call this negotiation bargaining, but they surely regard its product as some sort of worked out agreement. Other negotiations may be so implicit that the respective parties may not be thoroughly aware that they have engaged in or completed a negotiated transaction. (Strauss, 1978, p. 224–225)

The bargaining process is thus shifted into the background. Frictions are resolved by keeping them out of open discussions. They are settled implicitly through tacit agreement. For example, in his study of *Time* magazine journalists' approaches to investigating and covering policy processes within their own organization, Turow (1994) reveals how both journalists and superiors avoid coverage of salient issues because they implicitly agree that it is better not to address professional interests. The journalists fear for their jobs, and their superiors fear extreme organizational instability. Respecting each other's stakes, both parties implicitly agree that it is in both their interests to not open the topic up to wider discussion. This study thus shows that silence is associated with preventing conflicts from entering formal meeting rooms and official negotiations and keeping them far away from public scrutiny.

A consequence is that conflicts are rarely resolved by keeping things from public discussion or debate; they often reappear again in new, redefined and unexpected ways (Kolb & Bartunek, 1992; Zerubavel, 2006). People who engage in silent conflict management do not really communicate with each other, but accommodate the situation by respecting each other's vested interest. As a result, key issues that need discussion are not addressed (Kolb & Bartunek, 1992), and it becomes extremely difficult to change existing structures and systems. The result is that the status quo is often maintained.

The literature on silence thus shows that the way actors deal with differences and conflicts involves both verbal communication and silence. In particular, it reveals that silence is associated with the external and the internal dimension of the collaboration, and with managing the emergence of colliding interests. In the rest of the article, we use these three identified functions of silence to examine how researchers deal with the tensions and conflicts they have to confront in collaborative interaction. In particular, we believe that by focusing on silence we can get a clearer understanding of the way latent conflicts develop within these collaborative processes.

Below, we examine each of these three functions of silence, and their consequences, in the context of a study that investigated a large-scale interdisciplinary collaboration undertaken to reposition a university institution in relation to social challenge in the area of water management.

Background to the case

Examining everyday realities of academic collaboration requires an approach that pays attention to situation and context. To this end, we have used a case study design, which is useful for obtaining information on complex, context-dependent phenomena (Flyvbjerg, 2006). This case study explored the effect of moments of silence on the course of interdisciplinary interaction between researchers from water engineering in the context of consolidating the leading position of their parent university in the area of water management.

Water management is a vital issue in the Netherlands. The country is one of the lowest lying and most densely populated countries in the world. More than half the land is below sea level, making the future of water safety and liveability one of the country's greatest social challenges. The country also has a long history of innovatively dealing with water safety issues, in which priority is traditionally given to technical-engineering solutions to flooding, such as building dikes and dams. This fighting-the-water approach, as it is often called, was shaped by an epistemic community of civil engineers, employed at Rijkswaterstaat (The Department of Public Works), consultancies, construction firms and research institutes (van den Brink, 2009). Many of the engineers occupied positions at the university described in this article. This community was able to sustain the technocratic policy monopoly for decades, and it was largely responsible for the construction of the country's famous storm surge barriers (Bijker, 2002), but the balance of power shifted in the second half of the twentieth century.

Several intertwined developments caused this change. These include the rise of ecological awareness—partly triggered by the declining quality of nature and ecological issues created by the colossal dikes in the second half of the twentieth century—the decreasing authority of Rijkswaterstaat (van den Brink, 2009), and the introduction of new and democratic policy concepts that give voice to other groups such as scientific, governmental groups and private firms in decision-making processes about water management (Wiering & Immink, 2006).

Scholarship on Dutch engineering demonstrates that the relation of engineers towards politicians has come under great tension (van Rijswoud, 2013). Although engineering expertise is still considered essential in preventing flooding, a key challenge for engineering experts is to ensure that their specialist engineering knowledge remains authoritative as the dominant policy frame (p. 87). This means that the role of technocratic engineering approaches needs to be reconsidered in accordance with demands of openness, transparency and legitimacy in policy-making under democratic conditions (van den Brink, 2009). Given the need to adapt to new societal demands, it has become important to develop a common platforms and outlook between independent researchers from the university such as hydraulic engineers, spatial planners and policy and management experts to explore and integrate their different perspectives, values, and interests. In short: to shift the focus to working with water, rather than fighting it.

In recent years, a number of university-wide initiatives have been undertaken to construct such a platform and outlook. In our study, we investigated a high profile initiative to connect water engineering research to the policy challenges as posed by the Dutch Delta Program. This initiative is part of the broader integration of diverse water management research fields within the university, for instance shaped by workshops, lectures, partnerships, and scientific research projects.

The Delta Program is initiated to develop long-term water policies for the Netherlands in response to expected climate change impacts on society (Vreugdenhil & Wijermans, 2012). It supports the implementation of the second Delta Plan, which is meant to secure the liveability of the Dutch Deltas in the twenty-first century (Jong & van den Brink, 2013). The aim of the Delta Program is to incrementally elaborate, develop, and implement, an interdisciplinary vision on water management between 2011 and 2014. In the program, policy-makers and experts are brought together to explore and develop decisions and preferred strategies for meeting future challenges in water management. This vision is based on integral

solutions that are multidisciplinary by their nature and combine safety, economic, nature, tourism and recreational dimensions of water (Vreugdenhil & Wijermans, 2012).

The launching of the Delta Program provided momentum for water management scientists and engineers within their employing institution to strengthen relationships with stakeholders in the policy domain. In particular, the empirical research examined the university-wide collaborative process that preceded the hosting of a large national conference for the Delta Program in 2012. The aim of this conference was to engage diverse groups of water management experts, professionals, and practitioners working in the Dutch water sector to explore the role of science in determining new and productive ways of solving the country's long-term water management problems.

The water management research collaboration can be considered as particularly interesting when aiming to study silence. In its strategic focus on exploring how the university's separate water management research fields could fit better in today's socio-technical trends, it required more commitment and change than, for instance, working collaboratively during a single meeting or research project (Schuman, 2006). The creation of a common outlook required substantive discussion about values, beliefs, and interests. The collaborative activities also had an explorative character. Kaats and Opheij (2014) write that explorative collaborations are difficult to realize because actors join out of free will, they are not exclusively bound together and collaborate on an equal footing. They also attract parties that are not able to add any additional professional value or do not plan to do so (Kaats & Opheij, 2014). Neither is there a natural compulsion to determine the rules of the game. Initiatives often result from unplanned self-organization and are not well facilitated in terms of discussing group's tasks and roles. Given the unconventional combination of scientific fields, these collaborations are also less certain of locating funding niches in which to compete for funds, and a result is that actors may view each other as potential competitors (Shrum et al., 2007). Considering the collaboration's complex and explorative nature, our case study provides a unique opportunity to examine silence in the context of discussing, elaborating and bargaining how to collaboratively stage the importance and credibility of water management research.

In the next section, we outline our methodology. We then turn to the findings and describe several moments of silence in the nature and course of collabora-

tive interaction through which the researchers tried to deal with the tensions they faced in repositioning water expertise. We subsequently show how silence influenced the development of latent conflict.

Methods and analysis

To collect data, an ethnographic study of the collaboration was undertaken using an interpretative approach, which presumes that social realities are intersubjectively constituted and contextually situated, and can only be understood from within (Yanow, 2006). Customary ethnographic data collection techniques were used such as close observation, interviews, informal conversations and document analysis.

The interactions between scientists and other academics were studied by observing 25 meetings over a period of 7 months between 2011 and 2012. These meetings consisted of (1) working group meetings; (2) board meetings of the university's profiling platforms; and (3) preparation meetings. The working group meetings (8) brought together scientists from the faculties of civil engineering, architecture, and policy and management. In these meetings, we examined the collaborative interaction underlying the development and implementation of the strategic plans for the conference.

In addition to the working group meetings, we observed the board meetings (12) of 2 university-wide platforms that supported the collaboration financially and functioned as external advisory committees. In these meetings, we examined how the plans developed by the working group were discussed and aligned with other actors involved in shaping policy. Finally, in the preparation meetings (5), we observed how strategic plans were presented and discussed with people such as conference session leaders, representatives from the university's communication and policy department, and policy-makers from the Delta Program.

All meetings were attended and observed by the first author, who has a background in anthropology and is familiar with ethnographic data collection. Because of the relatively closed and confidential nature of the meetings, the researcher could not audio-record all field notes (e.g. Jarzabkowski & Seidl, 2008). Special importance was therefore given to producing written accounts of interactional detail; this was done through systematic jotting down and writing- up observation notes of meetings, as described by Emerson et al. (1995).

In-depth interviews were held with members of the working group, board members of the profiling platforms, important sounding boards, and professionals from the policy and communication staff. The informants (14) were interviewed before and after the conference. The chain referral method of snowballing was used to identify relevant informants. Interviews, which were audio-recorded and immediately transcribed, lasted an hour and took place at the informants' departmental offices. A topic list guided the interviews, which systematically explored the collaboration between the university and the Delta Program, actors' roles in it, and the interaction within the group. The interviews addressed the moments of silence that we observed in interaction.

In addition, there were lots of informal conversations—before and after meetings, during lunch breaks, at conferences—where we further queried informants about the process. Through informal contact, the researcher gained trust and broke down barriers, making it easier to talk with informants about specific occurrences and events. The informal conversations were less structured than the interviews, usually addressed one specific issue and provided opportunities for gaining in-depth understanding of what was going on (Denzin, 1991).

As regards the document analysis, we had access to formal and informal email exchanges relating to the project, which generated detailed information on issues that were negotiated outside of common meetings and thus gave insight into what was not addressed in the meetings. We finally worked through an extensive set of strategic plans, policy documents, mission statements, presentations, newsletters and other relevant material relating to the case. These were analysed in order to get a picture of official versions of the collaboration's progress and revealed what actors did and did not share about their plans with other actors within the university.

For our study, we contrasted the diverse findings to identify moments of silence from the material. Through our method, we could capture and contrast

what was not being said in meetings and was spoken about outside of them, or only revealed to the authors (as in e.g. Gardezi, Lingard, Espin, Whyte, Orser & Baker, 2009). To analyse the material more deeply for silences, we used Clarke's (2005) situational analysis. This approach makes it possible to visibly show unexpected and often-overlooked aspects of such differences, controversies, absences and silences. Situational analysis is particularly useful to 'articulate what we see as the "sites of silence" in our data. What seems present but unarticulated?' (Clarke, 2005). Situational analysis can be compared to conventional grounded theory, using similar techniques such as coding, memo making and sensitizing concepts, but takes the whole situation rather than the individual as the main unit of analysis (p. 85). The analysis involves an iterative process of appraising and re-appraising the data, and mapping the relations, concerns and controversies between various elements, thus capturing the situation's complex, contextual dimension. Carrying out this situational analysis of the collaborative processes allowed us to identify more clearly the moments that could be analysed with the help of theory.

In the results section, we present these findings by relating them to the three functions of silence discussed previously. We do this by contrasting data from observations, interviews, conversations, email exchanges and documents. Our intention is not to give a streamlined account of the collaboration, but only to highlight several important moments at which silence emerged in interaction and identify its functions, and unforeseen consequences for interaction, in these contexts.

Findings section

Silence and group performance

In this section, we discuss the initial working group meetings in which scientists explored possible scenarios for the conference. The collaboration started with a large kick-off session in which a delegation of the university's top professors and researchers in water management and representatives from the Delta Program jointly agreed on the importance of bringing science and policy closer together.

After this large kick-off session, a smaller working group was put in charge of strengthening further relations between the program and the university, consisting of scientists from the university's faculties of civil engineering, spatial planning, and policy and management. The group's effort was also anchored in two university-wide boards, which supported and facilitated the group and functioned as an advisory committee.

Looking first at the working group meetings, we found that members generally spoke positively about one another and the joint initiative, which was seen as a response to external changes and challenges that required the support of all members. One of the group's engineers expressed the importance of achieving a shared objective in an interview as follows:

> 'We are making a big investment to come closer to the Delta Program because there are social questions to which we can contribute. … They won't come to you by themselves even though we have the tools that could very well

> fit their needs. Action is needed in the direction of the program ... we are all behind it.'

In the conversations we observed, we found that participants focused mostly on understanding the realities external to the meetings. Group members usually discussed the increasing uncertainties they faced, speculating about motivations of competing parties, who was close to the money supply and which projects would produce the most tangible result. In contrast to these discussions about external challenges and dilemmas, less time and energy were invested in exploring internal opportunities and challenges within the working group, such as for instance how to balance and integrate values and expertise and build on each other's strengths during the conference.

A striking feature was that group members rarely questioned group tasks, individual roles, or each other's reasons for participating in the group. The question of how to present their joint expertise at the conference was also only raised on two occasions during the meetings. On these occasions, some researchers emphasized the importance of presenting and debating the relevance of scientific approaches, while others were of the opinion that it would be best to demonstrate real-world technical innovations that were in the process of being developed at the university to their audience. While everybody was allowed to raise their ideas and opinions, differences in perspective were rarely explored or debated during interaction. After group members shortly conveyed their perspective on the situation, the others were silent and did not take the discussion any further. Rather than asking for clarification, the chair generally moved onto another topic without seeking substantive agreement.

Personal conversations similarly suggested that internal consensus about the project was assumed rather than debated. When we asked informants why they did not talk more extensively about their expectations and perceived purpose of the conference, they downplayed the importance of differences in this process claiming that they did not need further discussion and everyone agreed on the chosen course. A policy scientist put this rather clearly when she replied that, 'We do not need to talk about our differences. Everybody wants the same thing. That's obvious'. Another told us that 'not everything always needs to be discussed'.

Observation furthermore revealed that time pressure was a factor in avoiding difficult issues. Several senior members were committed to the project, but also

had to deal with very tight time schedules. During the meetings, it was explicitly stated by several senior scientists that the meeting was interrupting other important work and that they should get on with the meeting as quickly as possible. On one occasion, the chair opened the meeting by stating, 'Let's get this thing over with as quickly as possible'. The members were not expected to prepare themselves for the meetings. Interaction during the meetings was often interrupted by phone calls and conversations about other unrelated projects. Meetings also often ended abruptly, leaving insufficient time for decision-making. Generally, the interaction at meetings was very collegial and friendly, and was strongly oriented towards behaviour that did not lead to disagreements between participants.

The consequence of this was that the project gained a forward-looking character. Getting the task done as expeditiously as possible was seen as crucial, and talking about differences would slow down the pace of the project. As one of the engineers said, 'Talking too much doesn't get you anywhere. We shouldn't make things too complicated'. Another scientist echoed this feeling, stating that the burden of having to discuss differences potentially slowed down the process. A policy scientist mentioned that they were particularly good at completing tasks as quickly and efficiently as possible: 'Doing things, and not talking about them too much, that is the way we typically do things around here, stop rambling—just do it, that's our motto'.

In brief, this section has shown that an external challenge provided impetus for the scientists to turn towards one another to pursue the common goal of creating an appealing, interdisciplinary image of engineering research at the conference. In this early phase, all the participating group members supported the selected course of action and individual differences scarcely made it to the table of group meetings. When they did, nobody explored them in detail. Topics that were disused instead focused on issues that everyone appeared to find at least temporarily acceptable and were consonant with the assumed goals of the group (Goffman, 1969). Although this gave the initiative an uncomplicated, forward- looking and externally oriented character, it also prevented profound exploration of differences in visions and perspectives that often underlie complex interdisciplinary collaborations. In short: substantive agreement was not sought.

Surfacing differences

Despite the shared sense of unanimity that existed within the group in the initial phase, differences within the group started to surface as the collaboration moved towards its implementation phase, and actual decisions about the content of the conference (sessions, speakers, formats and so on) were required. When the collaboration shifts from outwards to inwards, members move from criticizing authorities and the external world—their common nemesis—to developing their own internal visions (Farrell, 2001). This can bring about new and unforeseen differences that bring to light potential tensions (Sonnenwald, 2007).

An important source of friction in the relationship was observed between the scientists during group meetings. As the conference drew closer, differences in disciplinary vision that had not been discussed in the early meetings emerged. An illustrative disagreement concerned a spatial planning member's proposal to include a keynote speaker without a technical background to provide a talk on the history of water management to emphasize the socio-technical rather than just the technical scope of the conference.

One of the civil engineers objected to the idea, suggesting that such an opening lecture would conflict with the technically oriented engineering disposition on flood safety and security and would give the wrong impression because it contradicted the values and mission of a technical university. This remark was ignored and received no further attention at the meeting. Interpersonal differences were not examined within the group, but the interviews reveal that disagreement lived on beneath the surface and created negative sentiments between the respective group members. As the engineer explained:

> 'I did not mean to say that the professor could not participate at the conference. I raised the issue to discuss whether the speaker corresponded with the mission and image we as a technical university want to get across … The team silenced my contribution in the discussion. … Even though you have good intentions, and join the group in addition to your own activities, you are always confronted with these negative stereotypes about engineers as ecologists' enemies.'

In contrast, the spatial planner referred to the incident in personal correspondence as evidence that civil engineers tended to view problems through a technical lens:

> 'Inviting a historian to give a talk immediately means that you are seen as nostalgic … that she talks about our water tradition over the last 300 years does not mean that it has no value in the present. … My analysis is that engineers are sometimes narrow-minded.'

This incident shows that group members began to agree less and less on the course that the collaboration was taking, but still remained silent about differences experienced in vision and perspective. Despite the silence in the working meetings, specific actors did voice their concerns outside of the meetings in more informal, backstage conversations, where they were often explicitly cynical about the course of the collaboration and expressed their discontent with the way things were going, eventually causing the engineer to leave the group. When the engineer and spatial planner met each other again in a later stage of the collaboration, in the context of a preparation meeting to discuss the content of the session the engineer would host, the silence was again maintained. Neither scientist addressed the disagreement in the meeting, nor why he had retreated from the group.

Escalation of the conflict

Differences thus surfaced at several junctures, but extensive discussion did not take place in joint meetings. As the collaboration evolved, brewing disagreements became more prominently visible and important at interactional levels beyond that of the working group. At a certain point, ideas have to be integrated into the wide institutional context (Jarzabkowski & Seidl, 2008). The network expands, and new actors and voices become involved in the collaboration.

When projects enter this phase, giants who have been dormant are often woken up. In our study, such a giant was one of the board's chairpersons, who gave voice to the latent sentiments that were already present in the collaboration. The professor, a known spokesperson for classical engineering and defender of the fighting-the-water approach, and a well-known critical observer of current

policy changes (van Rijswoud, 2013), did not make a secret of his doubts about the program in an interview:

> 'As I see it, nothing will come out of the Delta Program. ... Those from the policy faculty are interested in it, because it is apparently about policy and decisions ... and they therefore consider it important, but the engineers know that it is powerless.'

His active involvement marked a turning point in the process. As chairman of one of the university-wide boards that supported the initiative, the professor's support was needed to back up the project financially. Faced with decisions that contradicted the disciplinary interests of his own field, the professor demanded more of a say in decision-making about the content and format in exchange for funding the conference through his board, leveraging manoeuvring pace for positioning his research agenda at the conference. In an email, he informed the group: 'I only want us to discuss serious solutions for the Netherlands ... I do not want to give room to romantic issues like "living with water" ... this university stands for feasible and practical solutions'.

The group members did not approve the request, and their response was expressed by a chairman of similar seniority who immediately responded to the email by instead accentuating the strategic and inclusive character of the undertaking:

> 'I think that it is more difficult than that ... this conference is all about moving strategically. We are trying to move the pendulum towards ratio and engineering, but we will not succeed by kicking it as hard as we can or by stepping on the brakes.'

As conflicting visions about the goal of the conference became tied to specific actors and vested disciplinary interests, internal parties were placed diametrically against one another. Several of the working group members did not agree with the classical engineering professor. For example, one of them in a conversation mentioned being annoyed about the professor's interference in the process, who in her opinion overplayed his task as an advisory committee board member. She referred to the professor stating that: 'the boards are interfering with the process,

where they should facilitate it'. Despite disapproving of his course of action, she did not say anything on the issue during the meetings of the working group or communicate her discontent to the members of the respective boards.

Similarly, two other working group members, who were responsible for informing the board members about the group's progress, did not address the issue during the board meetings, even though they grumbled about it after meetings. As a result, the conflict never made it to the meeting tables where all involved actors were present. Open confrontations were avoided and the conflict remained latent, even though most of our informants knew that others did not agree.

Personal conversations also illustrate that nobody wanted to openly debate the issue. One informant told us that discussing the issue with the professor was futile; another that it was better to let 'things naturally resolve themselves', subtly pointing to the professor's upcoming retirement.

Similarly, another member explained how the professor had previously complicated efforts, and that everyone had grown tired of debating with him on crucial issues: 'this is what always happens, we have become accustomed to it'. The board member of equal seniority echoed this difficulty of addressing longstanding disciplinary differences:

> 'The difficult thing is that, without pointing fingers, our board differs from theirs in many ways … they have entirely different disciplinary concerns and tasks, and this difference surfaced in the process. And yes, one can try to coordinate that … But I also think that there are some real differences that are not easily bridgeable. Putting all this effort into trying is not worth the energy. … It seems better to just continue under our own flags.'

Despite the fact that they disagreed, nobody thus felt the urge to openly address the conflict. After a short email correspondence, the professor was informed by the group that several of his demands would be granted, in return for his support for the initiative and silence on the issues important to them. Nobody bothered to sound him out and find a more productive solution. Here silence is explicitly demanded in a bargaining process; it is used to create a situation in which the issues could be resolved without having to address each other's stakes in the process.

Once the issue was settled, things quickly got back on track: the original conference program was rewritten, and more emphasis was placed on autonomous research agendas and well-known disciplinary perspectives. All partied were given an equal say in the matter and were allowed to host their own session, even though this was contrary to the aim as defined at the beginning of the project to create an interdisciplinary approach to the conference. They started working alongside one another and minded their own projects, without contributing to an overall vision. Once the working group proceeded with the organization of the conference, no further problems occurred, so the conference could be held and attracted some 1,500 professionals from the field.

Initially, the informants were enthusiastic about the conference, but in retrospect they mentioned that the event had not entirely met their expectations. An engineer, who had functioned as a flywheel for the group, explained rather cynically that he was disillusioned with the effort and had gradually lost his initial enthusiasm. Two senior scientists mentioned that they had not succeeded in conveying the university's shared strength, noting that it did not have a strong, integrated character.

Although informants expressed concerns in informal conversations, these concerns again did not attract much debate in the evaluation meeting held several weeks after the conference. During this working group meeting, the participants referred to the events as a success, measuring this success by the attendance at the conference in general, or at their own sessions and contributions. The question of whether they had accomplished shared goals was consigned to silence.

Conclusion: functions and consequences of silence in interdisciplinary collaboration

This article began with a broader set of questions about the role of silence in interdisciplinary collaboration geared towards developing socio-technical approaches to public problems. To gain more insight into these questions, we analysed empirical material from a case study examining collaboration in water management, in which scientists from different fields and faculties and with a strong own agenda had to work towards a consensus and represent the agenda of their close colleagues and group. This collaborative challenge required discussing deep-seated differences and the reconfiguration of pre-existing relationships between actors, even though there were often insufficient opportunities and resources to facilitate a serious time commitment.

The case study demonstrates that, when scientists from different fields and faculties collaborate around university-wide challenges, relevant issues are kept from the common meeting table and are only talked about within we-groups, even though discussing important issues and problems would add to the quality of decision-making (Dörner, 1996). Building on the theoretical section of this article (Morrison & Milliken, 2000; Perlow & Repenning, 2009), we identified three functions of silence in collaborative interaction: securing group performance, dealing with relationships within the group, and managing conflicts of interest. These silences furthermore have unforeseen consequences for collaborative interaction.

Considering first the group performance function, the case study suggests that silence is associated with maintaining within the group the solidarity needed to ensure a workable situation. Getting scientists from previously independent

parts of the university to collaborate around challenges in their external environment is notoriously difficult; it requires the involvement and commitment of multiple actors of roughly equal status that are not exclusively bound to one another (Kaats & Opheij, 2014). When participants collaborate to work towards common achievements, silence may be used to create a 'working consensus', a modus vivendi for everyday interaction (Goffman, 1969). As our study revealed, during group meetings scientists do not openly question or contradict each other's perspectives, regardless of different outlooks they may have on the positioning of their research. Differences internal to the group are temporarily kept out of exchanges to reach a consensus. This consensus is not based on candid and open discussions between participants and does not denote substantive agreement. It instead relies on silence in that participants conceal their own perspectives in the benefit of the group's shared objectives and interests (Castaán Broto, 2011).

This silence is strongly encouraged by the performance pressure of this type of collaboration, in which lack of time and resource vulnerability causes researchers to become task-focused. Under high pressure and time constraints, researchers will not take the time to properly address difference in perspective or will not see it as their core task, thereby profoundly influencing the internal exchange and examination of ideas and differences.

Second, with regard to the management of disagreements within the group, our findings show that, when differences in vision and perspective present themselves more forcefully in interaction, researchers may still not move towards openly addressing and examining them. Collaboration is an unpredictable and uncertain process marked by continuous change (Shrum et al. 2007; Sonnenwald, 2007). If the process takes new and unexpected directions, researchers can be confronted with differences in interaction, and suddenly have to explain where they stand, which can feel like having to defend their position. People, however, generally dislike social disapproval (Aarts et al. 2011). They may feel vulnerable or fear being misinterpreted. In order not to lose face, they withhold their full expression about the issues and try to regulate the impression they make on others (Argyris, 1980; Goffman, 1969).

Although this keeps interaction conflict-free and relaxed (Aarts et al., 2011), a consequence is that people feel that they are not heard in interaction and start to experience initial agreement as a burden. As shown in our study, not exploring one's own perspectives or inquiring into the thinking behind those of others

leads to negative attitudes about one another, reinforcing stereotypes. When people keep negative feelings to themselves, uncertainty increases, and people are no longer sure what others really think and what will be talked about or not (van Woerkum & Aarts, 2008). This has a disintegrating effect on group relations, pulling collaborators in opposing directions where mutual understanding is needed. As our study points out, not discussing differences causes important group members to silently drop out of the process as a result of which potentially valuable knowledge and input is lost.

Regarding the third dimension—the role of silence in the management of conflicts—we illustrated that scientists will not explicitly confront colleagues who put conflicting interests on the table, but will respect one another's stakes and resolve the issues by silencing their differences. Collaborations that have a strong explorative character are especially prone to attract parties that will step up and use their authority to prioritize disciplinary interests that run counter to shared goals (Kaats & Opheij, 2014; Shrum et al. 2007; Sonnenwald, 2007). When influential actors revive old disputes, others will find it difficult to oppose them and resolve their differences by means of discussion because this can damage the position of their own department and relations with other departments and professors, or at least could make them considerably more difficult. Given the largely voluntary nature of participation in such collaboration, and the absence of financial incentives, it is unlikely that scientists will become involved in heated discussions with colleagues in specific departmental and hierarchical relationships. As a result, conflicts will often remain invisible (Kolb & Bartunek, 1992).

Although silencing conflict is an important way of dealing with relational pressures (Perlow & Repenning, 2009), an unintended consequence can be that it closes off discussion about deep-seated issues and problems that require open and reciprocal interaction between old and new parties. As our case study shows, during the crucial phase of the collaboration, differences were silenced and new goals were redefined that no longer reflected the initial purpose of highlighting the joint relevance of water research from a socio-technical perspective (Pahl-Wostl et al., 2007). Instead it supported well-known and established interests and agendas. Ironically, silence undercut the very objectives that people set out to reach in the first place by erecting interactional barriers to solving urgent social problems.

Following from this, we suggest that a self-reinforcing cycle is involved in silence in collaborative interaction. When used to protect group performance,

silence prevents researchers from challenging one another's views and perspectives. As a result, internal differences at the heart of the collaboration are not explored, making it exceedingly difficult to address them if they arise in later stages. As conflicts from the past become apparent and gain more weight, it is usually already too late to adequately address them, and a deep gap will emerge between parties. As conflicts flare up, researchers will quench them with more silence, and this will further add to polarization. Differences are magnified and it becomes even more difficult to resolve issues and problems the next time parties meet. As Zerubavel (2006) notes, "The deeper the silence, the thicker the tension that builds around it" (p. 84).

Although functional from different perspectives and for several reasons, our analysis thus suggests that the longer differences remain undiscussed, the more silence will influence the course of interaction and increase the probability that latent conflicts develop. Seemingly unimportant everyday silences in the end shape collaboration in ways that no one may have intended. This conclusion offers an interesting new look at interdisciplinary collaboration, yielding new insights into the process of everyday management and accommodation of tensions and conflict (Hackett, 2005; Shrum et al., 2007; Sonnenwald, 2007).

Finally, the study has several implications for the management and organization of interdisciplinary collaborative processes. Collaboration requires that researchers accept differences and diversity and are ready to openly discuss diverging viewpoints and underlying assumptions and interests. Many authors acknowledge and emphasize the importance of having productive conversation about difference in this process (Bukvova, 2010; Jeffrey, 2003; Lewis et al., 2010; Pearce & Littlejohn, 1997; van Oortmerssen et al. 2014; Wenger, 2000).

In order to engage more effectively with differences in interaction, it is necessary to take into account that the choice between speaking up and staying silent makes a difference and needs to be addressed. This can for instance be done by giving special emphasis to designing the structure of and organizing the conversational process so that the participants effectively engage in collaboration (Schuman, 2006; Taylor & Szteiter, 2012). A well-facilitated collaboration process can encourage listening actively to each other, foster mutual respect, and elicit more insight into each other's perspectives (Stanfield, 2002).

Facilitators can also play an important role. According to Hanson (2006), a facilitator is a nonvoting member that can preside over the forum in which the

exchange of ideas takes place, ensuring that all voices are heard. Hanson (2006) writes, 'a facilitator has a great deal of influence in his or her most invisible and silent role' (p. 140). Facilitator can for instance keep a common and publicly accessible record, create safe interactional forums to discuss important issues, and ensure that the right types of conversations are held in different social contexts (Ford, 1999).

Externally facilitating the process, however, is not enough. Academic leadership also plays an important role in empowering other scientists to share and communicate collaborative visions and achieve higher forms of performance (Sonnenwald, 2007; Stokols et al., 2008). However, as the present study suggests, scientists that occupy leading positions may not always address difficult conversational issues, sometimes unintentionally undermining the goals they seek to achieve. In part, this may be because they are not well equipped to engage in and facilitate these conversations. Although scientists might consider themselves experts in communication —a significant part of their work entails explaining their research to other scientists,—they may not necessarily be good at discussing how to integrate distinct visions or interests or know how to solve conflicts that arise in complex collaborative settings. In the light of the above, is seems advisable to develop initiatives to improve the conversational skills of scientists in general, and scientific leaders in particular, so that they can constructively discuss, negotiate and resolve tensions that are likely to arise in the course of collaborative interaction.

We have offered some initial ideas on the role of silence in collaboration. Further studies may benefit from examining more directly its role in the development of latent conflicts. An important avenue for research would be to define the critical points at which different functions of silence interact and begin to reinforce each other. Such research might respond to Perlow and Repenning's (2009) call to determine the tipping points in which 'silence shifts from being a productive response to isolated differences to a self-reinforcing pathology that can significantly reduce organizational performance' (p. 216). In terms of further research, it would also be useful to investigate functions of silence in relation to the different types of forums (from email to workshops) in which interdisciplinary collaboration occurs.

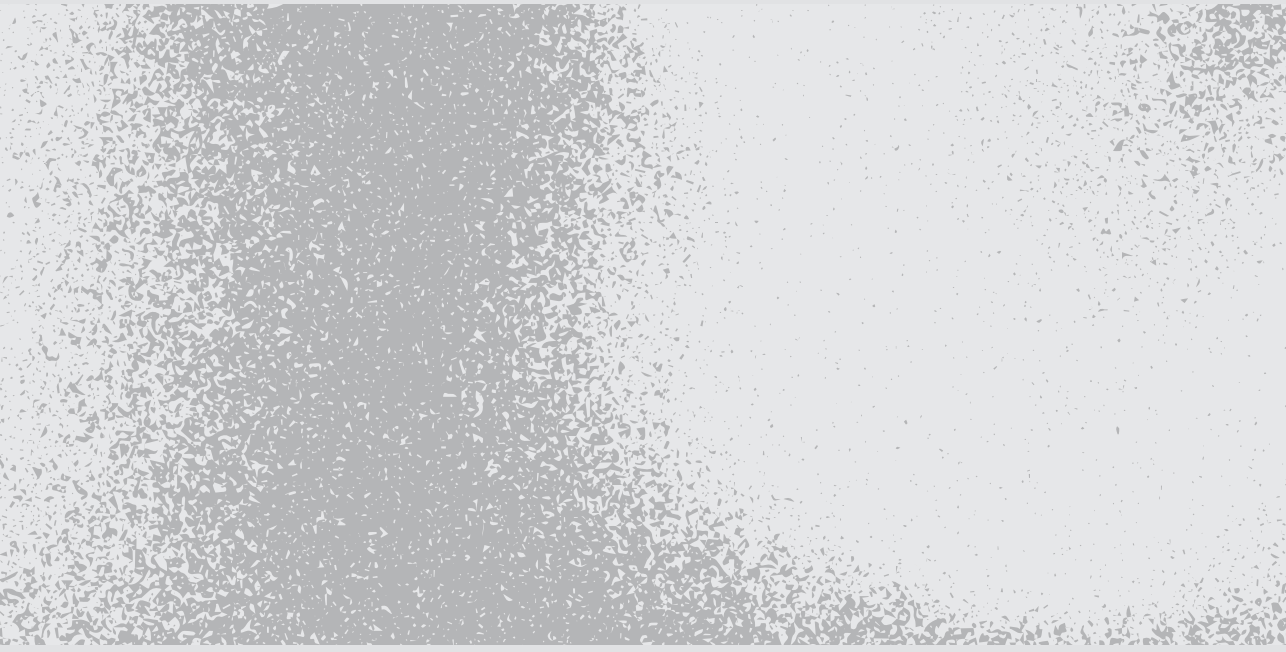
The study also opens up some interesting questions with regard to our ethnographic reflexivity; in other words, our own silence. In designing the study, we

did not set ourselves the goal of intervening directly in the research collaboration process, as is for instance emphasized in action research (Taylor & Szteiter, 2012). We did not encourage participants to reflect more systematically on what they were saying and not saying during interaction. Nevertheless, we emphasize the value of transparency in the research process and the importance of giving back conclusions to research participants. In our research, we have been transparent about expectations and research objectives from the start, for example explaining to participants that we were not part of the collaboration.

In terms of engaging with the social dimension of our research, we conveyed our experiences and findings in the form of a symposium on the topic of silence, during which we reflected on and discussed its significance for ongoing and future projects together with research participants and other relevant institutional actors and stakeholders. Through this symposium we have made an initial step towards opening up a forum within the university for creating a dialogue around the topic of silence in scientific collaboration. Given the conclusion of our research, it seems wise for universities to facilitate safe spaces for scientists to talk about and share their perceptions of and experiences with silence in ways that enrich their understanding of its role in the everyday practice of collaborating.

03

ENGINEERS AT THE PATIENT'S BEDSIDE: THE CASE OF SILENCE IN INTER-INSTITUTIONAL EDUCATIONAL INNOVATION



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Introduction

Innovation in science and technology is increasingly linked with interdisciplinarity. Encouraging this trend depends in part on cutting-edge educational programmes that revise, reinvent and redesign curricula as interdisciplinary vehicles, establishing and re-establishing relations between traditional fields and areas of expertise (Casey, 1994; Stone, Patton & Heen, 1999). Such programmes are valuable because they can overcome 'silo' mentalities and equip prospective students with the skills and knowledge necessary for understanding and solving complex societal problems (McFadden, Chen, Munroe, Naftzger, & Selinger, 2010; Stone et al., 1999).

Although these programmes are very promising, their development and implementation also brings challenges. The literature on curriculum development shows that many programmes have struggled to achieve true integration (McFadden et al., 2010; Stone et al., 1999;). Dam-Mieras, van Lansu, Rieckmann and Michelsen (2008), in their study of an international master's programme in sustainable development and management developed collaboratively by nine universities, observed that universities have their own experts and own programmes and that the 'not invented here' argument influences how details about new programme are discussed. Focussing on innovative online instruction courses, Xu and Morris (2007) found that the absence of group cohesiveness between faculty and project coordinators can hinder the collaborative course development process and affect the quality of the end product. Stone et al. (1999) emphasize that fac-

ulty members and administrators work at cross-purposes and view each other's initiatives with suspicion. Given the importance that scientists, academic institutions and policy makers ascribe to innovation, along with their assumption that such innovation is a sure result of interdisciplinarity, it is essential to gain a better understanding of how curriculum development in academic education actually works.

For this chapter, we consider how processes of connecting and interrelating could add to our understanding of the problems and dilemmas that arise in developing and implementing such programmes. Scholars of innovation, in science and technology and beyond, have explained that innovation is not some abstract algorithm: it relies on interaction and collaboration between multiple actors with different expertises, visions, priorities and investment (Akrich, Callon, & Latour, 2002; Fonseca, 2002; Leeuwis & Aarts, 2011; Van Bommel, Aarts & Klerkx, 2011). This process of interacting is very difficult, however, and creates many tensions. This is revealed by studies that show the lurking problems of connecting previously unconnected people around new ideas and technologies. These studies show how innovation processes become defined by competition for scarce resources, protracted negotiations over priorities and interests, and dynamics of inclusion and exclusion (Leeuwis & Aarts, 2011; Pretty, 1995; Van Bommel et al. 2011). Fonseca (2002) hence explains that innovation always creates a paradoxical situation, in which organizations, in their search to accelerate change and adapt to and find solutions for external challenges and demands, unavoidably create new and unpredictable interactional patterns.

Given that interacting is a complicated matter in innovation processes, a key question within the management of innovation literature is how we can account for the way relevant actors connect, or fail to connect (Akrich et al., 2002). In this respect, verbal communication is often cited as an essential mechanism for effectively connecting important actors and social groups around innovative ideas, products, or technologies (Van Bommel et al., 2011). In turn, the markers of effective verbal communication as a frame for innovation are seen to be openness, dialogue, and the ability to cooperate and be reflective on one's thoughts and actions (Stilgoe, Owen & Macnaghten, 2013). Thorp and Goldstein (2010), writing about university innovation, describe conversations as the fertile ground from which innovation grows and urge us to make time and space for those conversations. Dialogue and openness are seen as indicators of the quality of interaction, and

process transparency as a decisive component of academic innovation. By being open or transparent in discussing issues and problems, actors build confidence that negotiation is 'real' and not a cover-up for private backroom deals (de Bruijn & ten Heuvelhof, 2008).

Although there is a wealth of research on communication for innovation, most scholarly work focuses on what is exchanged verbally, on how actors collate all the relevant evidence, put it on the table and discuss it openly. As of yet, silence is absent from these studies of communication for innovation. Building on recent organizational and strategy scholarship, in which silence is approached as an intricate concept with powerful functions and meanings in social interaction (Carter, Clegg & Kornberger, 2008; Henriksen & Dayton, 2006; Jaworski, 2005; Morrison and Milliken, 2000; Panteli & Fineman, 2005; Tucker & Edmondson, 2003; Van Assche & Costaglioli, 2012), we suggest that silence merits much more attention in analyses of academic innovation. This chapter therefore explores the role of moments of silence during interactions within networks developing and implementing educational innovation.

The structure of this chapter is as follows. We start by looking at the literature on dynamic innovation networks and communication and complement these insights with scholarship on silence within organization studies. After briefly introducing our approach, we present the findings of a study of an inter-institutional and interdisciplinary joint bachelor's programme that was implemented at the interface of health and technology. The purpose of the study was to better understand the significance of moments of silence in developing and implementing this programme. We end with the implications of our findings for steering in the context of interdisciplinary innovation.

A dynamic and relational perspective on innovation

Innovation processes have been much studied over the years. The traditional approach, dating from the 1950s, conceptualizes the application of new scientific and technological knowledge as an instrumental and linear process. In this view, specific strategies are followed, introducing planned innovations through a sequential process of stages or phases, all of them designed as part of a structured approach (Rogers, 1962). Each of these stages must be completed, as part of a ground plan laid down beforehand. Decision-making is a crucial aspect of this process and requires analysis, clear goals and good information (de Bruijn & ten Heuvelhof, 2008).

While this linear view of innovation remains dominant (Rogers, 1962), thinking about the subject has changed considerably over the past decades (Leeuwis & Aarts, 2011). Early models are now criticized for failing to recognize the full complexity of the background underpinning innovation and for overstating its manageable character (Fonseca, 2002). In contrast to the prevalent idea that innovation stems from the behaviour of individual geniuses and heroic entrepreneurs, who supposedly beat their own path as they develop and design their final products and deliver them to the public (Nicolini, 2010), we now see innovation as behaviour that is rooted in its social context and that must be explained as such. The direction and pace of innovation, according to this contemporary model, is determined by the continuous interaction and negotiation of multiple actors positioned within networks and inter-organizational projects and influenced by con-

tinuous interference from specific policies and external circumstances (Fonseca, 2002; Gladwell, 2000; Leeuwis & Aarts, 2011).

Within innovation research there is a strong interest in how such relationships come into being in multi-actor networks. From an actor-network perspective, Akrich et al. (2002) picture this process as including the constant recruitment and involvement of different kinds of actors who are potentially resistant to the introduction of innovation in society and who often fight tooth and nail to impose their own views on each other (Akrich et al. 2002; Czarniawska & Sevón 1996; Nicolini, 2010). As Akrich et al. (2002) write: 'An innovation in the making reveals the multiplicity of heterogeneous and often confused decisions made by a large number of different and often conflicting groups, decisions which one is unable to decide a priori as to whether they will be crucial or not' (p. 191). In this view, innovations are introduced by attracting the interest of an increasing number of allies, gaining their support and convincing other important actors and parties of their relevance.

For example, Nicolini's (2010) study of cardiac telemedicine, an innovative technology that provides health care at a distance shows how the acceptance of this technology involved establishing 'a space within the existing texture of medical practices by enrolling in successive waves a range of allies and support' (p. 1). In order for the technology to become 'an appropriate and legitimate way of delivering care' (ibid., 2010: p. 13), multiple actors (doctors, nurses, managers and health officials) first had to see its value and support it. For this to happen, it constantly had to be 'translated and metamorphosed into something else' in order to respond to conflicting demands and expectations. As this shows, making the broader public accept an innovation does not resemble a simple trajectory – "the picture of a curve which ends" – but is better described as something far more complex, a 'rhizome that extends itself by growing new branches and rooting itself in new ground' (Nicolini, 2010, p. 12).

As this illustrates, the process of innovating is not the work of single actors and does not follow blueprints that are laid out beforehand (Van Bommel et al., 2011). While individual contributions may be an important driver in the process, innovations become meaningful through linking and connecting the competing interests, wishes and dreams of multiple actors and interest groups within a network, a process filled with uncertainty and unpredictability.

Communication and conversations for innovation

Thus far, we have shown that understanding innovation requires us to focus on the complex interweaving of separate contexts of visions, perspectives and interests into a network. This does not necessarily mean that actors depend on a common practice or vision, but there does need to be some kind of 'overlapping consensus' in which parties with very different views and stakes agree that there is enough unity for them to accept definitions and ideas (Nussbaum, 2006). While we argue that silence is of crucial importance in creating room for manoeuvre, studies of communication in innovation usually highlight the significance of verbal communication in bringing about intended changes.

Leeuwis and Aarts (2011) explain that traditional models that conceptualize communication as an intermediary function, and prioritize the 'transfer' of information between individual senders and receivers (e.g. Rogers, 1962), do not capture the complex communicative interactions taking place between multiple actors in multiple sites. From an interactional framing perspective, 'meaningful innovation is dependent on changes in discourses, representations and storylines that are mobilized by interacting social actors' (Leeuwis & Aarts, 2011: p. 27). By framing vocabularies and arguments, participants seek to influence ongoing definitions of issues, identities and processes (Dewulf, Gray, Putnam, Lewicki, Aarts, Bouwen & Van Woerkum, 2009). They do this by proposing – or challenging – specific definitions and interpretations in order for others to start seeing the value of innovation from their perspective. As Gladwell (2000) has shown, when the innovation becomes the object of conversation, ideas get confirmed and this leads to their further introduction and distribution throughout the network. As a result, innovative ideas, be it messages, food, a movie, or product, become graspable, interesting and even memorable – or, as Gladwell calls it, 'sticky'.

At the most basic level, this framing process occurs in face-to-face interaction between actors, but these actors are also included in broader conversational networks that span multiple interactional settings. The ideas, plans or strategies that people talk about in one setting are interconnected with what they talk about in another. According to Krippendorff (2008), conversations are therefore the outgrowth of preceding conversations and fuel subsequent conversations. As Krippendorff writes, 'conversations leave behind their own histories of what happened, available to all who contributed to them, which serve as the expanding ground for

future conversation' (p. 156). To ensure that the right actors are clustering around an innovation, it becomes necessary to influence what interested parties, distributed across various sites and moments, say about innovation. Managing innovation becomes a matter of deliberately shifting conversations in the network and providing a new conversational context in which to interact (Ford, 1999).

The role of silence in complex relational processes

In broad terms, then, studies of innovation see innovation as the building of coalitions through the framing of messages and the creation of conversational contexts and networks that are likely to be of benefit to it (Krippendorff, 2008; Leeuwis & Aarts, 2011; Fonseca, 2002; Ford, 1999). Yet, despite the importance of verbal exchanges, it is widely recognized that people's behaviour is not only shaped by what they talk about, but also by that about which they stay silent (Carter et al, 2008; Morrison & Milliken, 2000; Panteli & Fineman, 2005). Although, to our knowledge, there are no studies focusing on silence in educational innovation processes, scholars have examined its role in numerous organizational and strategic contexts, showing how silence facilitates as well as complicates connections between actors. In this section, we review some of these studies and indicate their relevance as an additional perspective for understanding educational innovation.

Studies of ritual and performance in social interaction examine silence to reveal people's strategic attempts at realizing their goals and managing collaborative working relationships with co-workers. In their interactions with others, people speak about certain subjects, but not others, based on judgements and decisions related to regulating their appearance. From a symbolic- interactionism perspective, for instance, Goffman (1959) has shown that silence is used by participants to conceal their own feelings and perspectives in order to maintain a veneer of consensus. This makes us attentive to the discrepancy between people's behaviour in public, where many things are expected of them, and 'backstage', where they can speak more freely. Indeed, a roaring silence in the meeting rooms can be juxtaposed with people talking about things at lunch. As Goffman (1959) himself writes, 'employees will often grimace at their boss, or gesticulate a silent curse, performing these acts of contempt or insubordination at an angle such that those to whom these acts are directed cannot see them' (p. 119). This line of

inquiry shows that silence has a performative character; that is, it can be deployed as a strategy for not disclosing ideas and feelings with the aim of influencing and sustaining interactional processes.

In practice, there is usually not a sharp distinction between what is concealed and what is disclosed. Silence and talk are inextricably tied to each other. Studies of secrecy insightfully demonstrate how the dynamic interrelationship between keeping, telling and revealing secrets is essential for understanding organizational functioning and performance (Bok, 1989; Rappert, 2010; Vermeir & Margócsy, 2012). Although closed procedures are conventionally viewed with scepticism, Bok (1989) notes that secrecy and silence are as 'indispensable to humans as fire, and as greatly feared. Both enhance and protect life, yet both can stifle, lay waste, spread out of all control' (p. 18). In the light of the many decisions that are necessary at the various operating levels of organizations and institutions, it is essential to balance openness and secrecy, sometimes articulating issues very publicly, sometimes managing them discreetly.

For example, in their study of the Dutch Health Council, Bijker et al. (2009) describe how the preparation and communication of scientific advice and policy is marked by a contradiction between the obligation of transparency and public consultation, on the one hand, and the need to resist the power of lobby groups, on the other. The authors illustrate how the Dutch Health Council deals with this paradox by constantly shifting between procedural forms of transparency (information that is openly communicated, such as summaries of minutes intended for public display) and substantive forms of transparency (scientific information that is only discussed backstage, such as council meetings that are closed to outsiders). By constantly switching between openness and closure, the Health Council is able to control how views are ventilated and discussed, for example making it possible for the Council's members to develop ideas without the interference of dissenting voices and lobby groups. Seen in this way, temporarily excluding certain voices is an important condition for maintaining the democratic function of the Health Council. This research thus illustrates that what is talked about and kept silent constantly interact with and influence each other.

Scholars of strategy have furthermore argued that this interplay between silence and talk is also continuously changing. These scholars have tied silence to the unpredictable and unfolding nature of the strategic process. According to Carter et al. (2008), strategy occurs in an unfixed and highly dynamic interactional

context in which numerous competing voices seek to define their strategies. They argue that silence can be used to examine the absent, but nevertheless crucial, aspects of strategy making. Simply put, for every decision, agenda point and actor present at a meeting, there is an issue that remains unspoken and undecided, something that is omitted from the agenda, and someone who is not present or has not been invited. Because competing voices always seek to define their strategy, what is silenced at one moment can still become potentially relevant at other moments throughout the process, undercutting the power and authority of official discourses and strategies. Van Assche and Costaglioli (2012) hence propose seeing the strategic planning processes as a 'series of sites of silence' in which plans are constantly being reinterpreted and redirected. Each interactional site will highlight new combinations between silence and talk, and has the potential to reshape concepts and plans (Assche and Costaglioli, 2012, p. 42). In drawing attention to the unfolding nature of silence and talk, strategy scholars thus make us attentive of the fact that silence is part of a layered and unfolding series of interactional patterns that are always changing.

The latter point is also addressed by the sociologist Niklas Luhmann (1994), who ties this emerging dimension of silence to the self-organizing nature of complex systems. Drawing on the theory of autopoiesis, as developed by Humberto Maturana and Francisco Varela (1988), Luhmann argues that social systems, like societies and organizations, consist of in-principle closed subsystems that try to survive and while doing so disturb each other. Systems generally constitute and reinforce their own boundaries through communication, but varieties of speech also actively interact with silence. When it is an act of communication, silence has the capacity to connect: 'Society can also include silence within communication – for example, in the sense of attentive silence, in the sense of an eloquent silence, or in the sense of "*qui tacet consentire videtur*" [one who is silent appears knowing]' (Luhmann, 1994: p. 34). However, Luhmann also refers to silence in a second sense, as an expression of the impossibility of communication. This silence causes threatening or chaotic elements from the wider context to remain unspoken and thus marginal, confirming and reproducing discourses in ongoing chains of interaction (Ford, 1999). In Luhmann's words: 'Every system coproduces that which, as environment, does not enter into the system, and this may then be called (!) "silence" – though silence in a second sense: silence without the ability to connect' (Luhmann, 1994: p. 34). Silence thus has a structuring function; that

is, while it helps to protect the system from chaos, it inevitably draws limits to what can be communicated, causing interdependencies between different parts of the network that cannot connect.

Studies such as these show that silence is not the absence of meaning and intention (Ephratt, 2008), but a performative action through which actors strategically seek to define the course of the interaction process. In order to grasp these dimensions, these studies emphasize that we must not only pay close attention to what is said and what is not, but also how these categories are dynamically constitutive of each other and continuously change across different actors and networks. Finally, these studies emphasize that silence does not only forge productive exchanges and interactions between people, but also unintentionally constrains these interactions and thus the way parts of the network connect with each other and their environment (Luhmann, 1994).

Although the literature reviewed here provides important insights into the role of silence in various relational and interactional processes, the role played by silence in the specific context of educational innovation remains unclear. From our theoretical considerations, we assume that silence also applies here. As previously mentioned, innovation processes by their very nature require the building of mutual interdependencies, but at the same time consist of opposing and shifting positions and movements. We suggest that exploring educational innovation through the lens of silence allows us to see more clearly how actors are trying to promote and achieve intended educational change (Ford, 1999), but also how the numerous interactions this requires can unintentionally complicate these efforts. As such, a focus on silence can provide an additional approach for attending to Nicolini's (2010) call to make visible the hard work of connecting required in the innovation process. In order to explore these issues, our study has been guided by the following questions: which moments of silence can be identified in complex multi-actor settings in the educational innovation process, and what are the unintended consequences of these silences for developing and implementing innovation across interactional contexts?

A case study of innovation in education

To generate more insights into the role of moments of silence in the course of the interaction process through which educational innovation is developed and implemented, we used an interpretive case study approach (Flyvbjerg, 2006). Interpretive case studies are particularly useful for capturing the ambiguities and subjective experience of social phenomena and are therefore appropriate to the study of silence, which is difficult to capture 'objectively'. The case study presented here examines an interdisciplinary bachelor's programme that was developed and implemented at the interface of technology and health. The programme was a joint initiative between a university of technology and two academic medical centres. Its primary aim was to educate professionals in both medicine and technology in order that they could apply this knowledge in healthcare settings.

In today's shifting medical landscape, healthcare problems increasingly require the application of medical tools and instruments for prevention, diagnosis and treatment. A medical specialist is increasingly expected to operate and interpret complex technology such as MRI scanning, echography, surgery and robot technologies. A central feature of this arena is the way it combines the time-honoured imperative of diagnosing and treating illness with the ever- greater impact of complex technologies. Responding to the growing need for such professionals, the joint programme set out to educate clinical professionals with knowledge of technology. These professionals could function as part of an interdisciplinary medical treatment team and independently carry out certain medical practices and diagnoses. For example, such a person might assist the preparation for sur-

gery by simulating the operation with biomechanical computer models or by supporting surgeons with operating robots, but also by carrying out simple diagnostic procedures at the patient's bedside.

In addition to its educational aim, the programme was developed in the light of wider strategic ambitions of the three academic institutions to work together and form an alliance in numerous areas of research and education. Hence, the programme also served as a tangible and high profile example of this coalition.

Given the main aim to develop this educationally ambitious and institutionally prestigious programme as a collaborative project, we considered it offered an interesting opportunity to examine the role of silence in the course of developing and implementing educational innovation. For the programme to become a reality, many complex interdependencies and relational processes had to be formed, which created ample opportunities for silence to become significant. First, a strategic internal network had to be established between the three academic intuitions. However, three-way institutional partnerships are not yet very common in higher education. They create many internal, administrative challenges in terms of facilitating institutional and faculty coordination; for instance, requiring additional support from senior administrators and faculty and staff development (Holley, 2009). Institutions may also have quite different missions and governance policies and cultures, which can result in an ever-growing complexity in the decision-making procedures needed to develop shared educational needs and benefits, budgets, joint quality standards, identification of support, and so on (Holley, 2009). While actors were clear in wanting to cooperate, the everyday reality required different kinds of professionals to engage in a daunting and complex collaborative process.

To build a successful interdisciplinary programme, it was also necessary to activate stakeholders and other interest groups and shape a climate favourable to its reception (Akrich et al., 2002). These wider networks differ from internal networks in that actors are not necessarily aware of one another. They do not engage in collective action and do not necessarily have a shared purpose (Knight, 2002). In our case, this network consisted of the wider scientific community, policy actors and medical interest groups, who did not naturally accept the new programme. Activating this network was especially complex because the programme wanted to include its trained professionals in the BIG-register. This register organizes qualifications and entitlement to carry out specific medical treatments. The plan

to extend the register made the programme controversial because it anticipated changes to the existing medical landscape and tinkered with responsibilities traditionally reserved for medical professionals such as doctors, physiotherapists and nurses. Previous studies, such as those examining career structures for radiographers (Coleman, Jasperse, Herst & Yielder, 2014), show that the acceptance of new professions is often met with resistance from established groups and professions, who fear for their career opportunities and their professional identities. Creating an external environment favourable to the programme thus involved dealing with these established groups and tied interests.

Implementing the new educational programme also required the shaping of relations at the work-floor level. The programme aimed to develop inter- disciplinary modules (combining knowledge from diverse medical and technical fields such as anatomy, physiology, pathology, mechanical engineering, electrotechnology and natural sciences) that encompassed multiple teachers across faculty and institutional boundaries, all with their own educational philosophies and perspectives on teaching. To build a curriculum, broader internal support from departmental heads was needed within and beyond the traditional biomedical disciplines and professions, as well as teachers able to develop and teach the actual courses.

From the above, it is clear that developing and implementing the joint programme constituted a significant challenge. It inherently implied 'a re-configuration of relationships within and between networks, and possibly the formation of new networks and/or the demise of existing ones' (Leeuwis & Aarts, 2011, p. 30). To illustrate the role silence played in these processes, we draw on thirty-four in-depth interviews conducted in 2013 with a diverse range of participants, including senior professors, deans, medical specialists, researchers and support staff members. The interviews examined the institutional and wider political context in which the programme was developed, the complex processes of internal decision-making between the three institutions and the realization of the programme at the work-floor level.

In the next section, we discuss silences in the three contexts addressed above. We first describe how silence was used to create a favourable external climate for innovation and then discuss its role in developing the programme within a small network of actors from the three participating academic institutions. We conclude by discussing the implication of silence for implementing the programme at the

work-floor level. In our specific focus on silence, we recognize that we have left out other issues and information that were also important to the process (Flyvbjerg, 2006). Such choices notwithstanding, we consider the instances of silence presented here as indicative of the dilemmas and tensions that arose in this educational innovation process.

Navigating a political minefield

As is often the case with very innovative academic projects, the collaboration did not emerge from the need for funding, but rather because some researchers saw it as an excellent opportunity to launch a new project that could lead to the development of a bold and imaginative idea (Shrum et al., 2007). Highly innovative projects are also typically too large and complex for a single team of academics and rely heavily on interested researchers to spread the story (Shrum et al., 2007). In this case, this was accomplished through a small committee of scientists and medical specialists from the three participating academic institutions. With their shared interest and belief in the value of introducing technically skilled professionals into healthcare practice, the committee members saw the programme's societal relevance and believed it filled an important niche in the medical field. As one of them put it:

> 'We believe that health care will go through immense changes because of the implementation of technology and that we have to be prepared for these developments. If you start in six years it is already a fact that you are lagging behind.'

The first group of professional colleagues involved were already supportive of the programme and at this stage there were few problems. The real challenge came when the idea had to be brought to a wider range of stakeholders – actors potentially sceptical of, or resistant to, the intended change. Several informants emphasize that the programme had to be developed in a very political and competitive environment in which different professional interests were at stake:

> 'It is a bit of a political minefield out there, because the medical faculties do not recognize this person working in clinical practice. From their perspective, they are a half doctor to whom you really cannot assign authority.'

> 'They are nibbling on vested interests and the finances that go with them.'

> 'The proposed model squeezes out certain groups: one comes; the other has to go.'

In addition to being politically sensitive, interviewees mentioned that academic interests also played a role in this process:

> 'Within the faculty there is also resistance. They always tell you that they already have so many problems. Why should we give money to students who are not from this faculty? Why should the faculty be coordinator of a programme that involves medical centres?'

While it is wise from a strategic point of view to communicate extensively with external parties who are not yet part of the network, getting them activated and involved, the intrinsically political and competitive context in which the programme had to be developed at times required a highly diplomatic approach. This meant that from time to time its promoters had to be discreet about developments or very reticent in providing detail. One interviewee explained that, when plans still need to be developed and are not yet fully supported, but the matter is such that it cannot be ignored for long, it is better to first let ideas and visions crystallize before engaging in difficult conversation with others:

> 'In the beginning you have to arrange so many things and it is very difficult to get everyone on board. … If you do not have an idea or vision and everyone is already informed, the process can degenerate into nothing or will be bogged down. Moving on and involving everyone is a delicate decision.'

Other interviewees also noted that medical interest groups known to be critical of the programme's inclusion into the BIG-register were approached very carefully.

One interviewee explained how carefully opening up conversations with vested medical interest groups by simply sending them a note, ran into a concrete wall:

> 'I sent the professional association a short note in which I asked if they could let me know if they considered the bachelor's a good development. From the seven professional associations that were notified, I received a response that they could not say anything about it. ... There seem to be some signs of cold feet.'

While parties often make their resistance heard, they are not necessarily willing to engage in dialogue, and instead protect and guard their boundaries and voice their resistance behind closed doors. This may make it undesirable to start up the conversation with them again.

In addition, plans have to be communicated carefully to academic colleagues who are not directly involved in the process but still need to be informed, such as those participating in joint interdisciplinary clusters or platforms. A support staff member told us about working in the medical cluster in which the participants developing the programme were involved:

> 'In my perception there is a lot of politics that causes people to restrict communication or not communicate certain issues at all. I have experienced this first hand, for instance when an initiative starts and you ask for input and do not receive any feedback. Meanwhile, colleagues are passing you by left and right and trying to pull work towards themselves. This makes people protect information.'

Information is thus treated carefully in exchanges with others. In addition, not much information was disclosed about the ongoing developments at the institutional levels either. While an informant from the technical university explained that he informed colleagues by giving a presentation about it, and that the programme was announced in the university's weekly bulletin, the medical institutions were less eager to be open about the programme, a choice that was not always clearly understood by informants from the technical university:

> 'They could not go public before everything was official. … That process remains very unclear to me. Everybody said that it was a good idea, but then everyone has to have his say in the issue, and this and that. Those in charge are clearly not in a position to pick it up simply because it is a good idea.'

From the perspective of the medical interviewees, announcing the programme was a question of waiting for the right moment to provide openness about developments. This decision was entangled with issues like the recognition of politically sensitive topics, the complexity of the policy environment, and the institutional cultures determining communication and sharing and reputational damage.

To sum up, while the programme was discussed and negotiated openly with many parties in the early stages of the process, not everything was disclosed to everyone at all times. The findings are suggestive of the trade-off that was necessary between activating and enrolling certain actors by telling and informing them about developments, and intentionally staying silent to keep others at a distance and allow room for manoeuvring in order to develop the programme in a meaningfully way.

Sidestepping issues

In addition to the external complexity, to get the programme up and running it had to go through a course-approval process. Learning outcomes had to be determined and assessed and standards of evaluation established. Naturally this required a very complex decision-making process across interdisciplinary and institutional boundaries, involving many different actors with varying levels of authority and with different mandates (such as senior scientists, deans and support staff).

Interactional processes as complex as these can be immensely difficult to manage. In our case study this was exacerbated because there was no single locus of authority, such as a director of educational programmes. Interviewees mentioned that actors were constantly changing and new people always had to be informed about the project from scratch. An interviewee mentioned that participants were constantly bringing new issues to the table and this swallowed up available time. Particular actors also perceived issues and problems and their solu-

tions in different ways, changing their minds during the process even when issues appeared to be settled. For many reasons, working across three institutions thus made it difficult to align multiple constituents during meetings and it became a great challenge to establish plans in a timely manner. A member of the support staff explained how this feature often caused actors to settle issues quickly while everybody was present, leading to short-term decision- making, with issues not being adequately discussed so that they suddenly resurfaced later on:

> 'People are generally very focussed on short-term results and want to make agreements the same day. In retrospect it is often apparent that things were not that easy and have to be presented 'ex machina' to take it a few steps further. This costs a lot of extra time to pull things together … an extra administrative round becomes necessary, which can lead to new perspectives and approaches. If you have already discussed things with people on the work floor or at other levels, this is a nuisance because everything then once again has to be changed and done in a different way.'

In addition to quick decision-making taking place during meetings, actors discussed and resolved things unofficially when particular people were not present. Waiting to settle things in meetings where everyone is present often means more discussion and can result in cumbersome questions that slow up the process. A key informant explained that it is sometimes just easier to reach agreements on small things informally, which then become a matter of 'ticking off' during formal decision-making. This does not mean that other actors or parties are not allowed to participate during meetings – the value of openness and transparent decision-making is usually endorsed – but it is seen as beneficial to the overall course of the process if unexpected and unanticipated contingencies can be resolved 'backstage' and the process can get back on track.

In addition to resolving issues backstage, actors may also intentionally limit the scope of subjects that are open to formal discussions. Complex inter-institutional collaborations naturally involve people with divergent professional perspectives and visions. In our case, not everyone necessarily agreed about the programme's long-term profile and positioning. Perspectives varied between seeing the bachelor's course as a stepping-stone towards a full master's degree or as vocational training that would lead towards a medical degree. Although parties

did not adhere to the same long-term vision, this was not necessarily a problem. Difficult subjects like the programme's long-term profile and students' career perspectives were sidestepped or not discussed in any detailed manner during meetings. An interviewee from one of the medical academic institutions explained how the important issue of the programme's final requirements was avoided during committee interaction:

> 'The subject was raised several times, but in the end it was simply avoided. At one moment we even discussed it for one and a half hours, but after that we moved on to the order of that day, because we want to start with the programme in 2014. That is the overriding goal. The choice has been made that the programme will be realized. … That is why we incidentally sidestepped the subject and simply moved on. I have seen that happen on several occasions.'

For the process to keep its momentum, certain difficult issues are thus not tabled. They literally must be pushed out of the room to allow for constructive debate on issues and problems that require immediate attention. Constantly raking up contentious issues and seeking the last word would clearly hamper the process.

While silence allows for parties to collaborate and work towards their goals, it can also mean that others do not know about particular communications. Two support staff members explained that meetings were often preceded by a process of 'pre-discussion' that often made the course of the process very unclear to them:

> 'I frequently did not have a clear view on what was going on because much of it was taking place behind the scenes. At one moment there was some fuss about the unbalanced division of the specialities, but to my surprise it was not discussed during the meeting. It simply never came up. … Obviously issues had already been settled between them, as they were never brought up again during the subsequent meetings. Instead we discussed other things I had not anticipated and prepared for.'

> 'High-level scientists and decision-makers have contact among themselves. That is not a problem. But it does mean that information streams remain completely unclear to me.'

When issues are not clear for actors it is not always easy to address them and get additional information. Because inter-institutional interactional processes are very unstructured by their very nature, it is often uncertain which actors will be present during which meetings. An interviewee explained how he could not find a good time to ask questions and get clarity about the programme's position:

> 'At one meeting I said out loud: 'Tell me what the benefit of the programmes is!' But it turns out that the right people are not present and you do not get an answer. ... The result is that the whole discussion is derailed and you have to return to it at another moment. At that point there is always a slight translation of what was discussed. What you said comes across in a different way. Sometimes forceful, and sometimes not so forceful, but never how you initially intended it to be.'

It is thus difficult to give internal feedback on the course of the process. When people do manage to do this, there is a chance that they will be wrongly interpreted depending on who is present at the table.

This section has described the friction between professional ambitions and available time. Everyone wants the programme to start within a short time frame and extensive debate would take up too much time. There is not much point discussing the programme's future if people disagree on this. This will come to the table at a later stage, but in the meantime some decisions on more pressing matters will have to be taken. Participants thus focus on things that are feasible in the short term and leave long-term 'dream' projects for later discussion. Visions can coexist side by side because they are not articulated: a silence is maintained. This indicates that silence has benefits for the collaboration; it helps short-term decision-making, but also causes things to become unclear for those who are not actively involved in these decision- making contexts. As we will see more clearly in the next section, silence had unintended consequences for those working in other contexts within the network and phases of the process.

Quick fixes and working backwards

In the decision-making context, the programme still exists mainly on paper. To become a workable programme, effective curriculum design and implementation is needed. This required the involvement and support of new allies in the form of departmental heads and teachers from the participating academic institutions. For this task, a group of domain experts from six technical and medical domains were called in to spread the word about the programme and to inform, motivate and involve departmental heads and teachers across the three institutions.

For the disciplinary domains where collaboration between engineers and medical specialists was already common practice, achieving a working programme posed few difficulties. However, involving people from the clinical workplace was a more significant challenge. Departmental heads and teachers were often weary and morale was lower. Before committing themselves, they wanted to know more about the exact implications of the programme for the medical 'shop floor' or for students' career prospects; issues that until now had mainly remained in the background. As two interviewees explained:

> 'Medical specialists see the programme as a threat; not enough attention was given to involve them. … There is some resistance from the clinical side because people first want to know: what exactly is this programme? What is this person going to do? How will he be deployed? People did not communicate enough about these issues.'

> 'When I ask my colleagues whether they want to teach a class in the programme, they listen and seem interested. But then there is the 'yes, but'. That's the way these conversations go.'

The domain experts also explained that they often could not respond to these questions, for example because there were no documents intended for internal discussion and deliberation. The paperwork that might construct strong and appealing stories connecting all the actors in the network did not exist (Krippendorff, 2008). According to one interviewee, this made it impossible to illustrate the programme's relevance to actors with strong opinions:

> 'Of course the specifics have all been thoroughly written down at a certain time, because that is officially required. ... But what you really need is a condensed form ... that can get the message across unambiguously under teachers and departmental heads. That it how things begin to resonate and how you create widespread support.'

More significant than the absence of documents was the lack of visibility and formal support from the medical institutions. Several interviewees explained how the lack of publicity and information about the programme on the university's website complicated discussions in the workplace. Despite initially being very positive about the programme, one interviewee stated that without visible support from academic leaders it was impossible to create a space conducive to open and active dialogue with departmental heads and teachers and to ensure the programme was widely popular:

> 'Without the institution's top-down support and openness it is nearly impossible to talk to, let alone convince, teachers. ... Senior people feel like you are stepping on their toes, with or without good reason. Others feel passed by. ... When asked for their cooperation, they respond by saying that they have heard nothing about the programme or that there already exists a similar programme elsewhere. Their response was generally that we should first go talk to their superiors. ... This is not the right starting point to excite and involve people.'

Without an official story it becomes difficult to contextualize plans and fit them into the frames of reference of other relevant actors. It also means that domain experts have to invest a lot of energy in finding quick fixes to solve more or less randomly occurring problems, much like a plumber who runs from one leaking pipe to another. One interviewee explained this as follows:

> 'The whole design of the programme should have been better positioned within the three institutions. Because it was not adequately anchored, everybody is now keeping the ball in the air because we want it to be a success. As a result, you constantly have to attend to and organize things afterwards that should already have been taken care of. ... The

> biggest problem with the programme is that we are continuously working backwards.'

Or as other informants from both the medical and technical universities commented:

> 'How shall I put it, it was a protracted process. … There was nobody behind it, no structure. Everybody just messed about.'

> 'Well, you can see it for yourself; it's all half-baked solutions, somewhat amateurish.'

It is widely pointed out that quick fixes can cause anxiety (Dorner, 1996; Henriksen & Dayton, 2006; Tucker & Edmondson, 2003). While all supported the process, several interviewees blamed its arduous progress for the disappointment or disenfranchisement they felt. Sometimes they were critical of those who had designed the programme:

> 'It sort of feels that you have been passed over.'

> 'Not enough time was spent at the drawing board to develop a workable plan.'

> 'The design was simply thrown over the wall. You should not do that. You should support the process and satisfactorily transfer it to others.'

As such comments illustrate, although people had good reasons to remain silent in one interactional context, this created uncertainty and became problematic when the programme needed to be implemented in another context. In particular, it created a situation in which the programme's strategic intermediaries, despite their initial interest and very positive attitude to the programme, could not immediately respond to some of the demands that confronted them. They had to invest their time in solving problems they did not anticipate, causing anxiety and decreasing motivation. As a result of this, the programme became framed in terms of challenges rather than possibilities and opportunities.

Silence as a strategy for facilitating collaboration

We started this chapter by showing that meaningful innovation is usually seen as a process dependent on changes in discourses, representations and storylines, and shifts mobilized by multiple and constantly interacting actors and parties (Ford, 1999; Leeuwis & Aarts, 2011). Assuming that silence is also significant in this regard, we used the case of the inter-institutional bachelor's programme to illustrate that, throughout the whole process of developing and implementing the programme, silence was as performative as verbal communication. Strategic and intentional forms of silence are often conceptualized as a tool to secure personal gain, as in the denial, distortion or neglect of the facts (Oreskes & Conway, 2010). However, our study shows that whether specific strategic silences are intended positively or negatively depends on the situation and may be subject to contrasting interpretations within a situation. The presented study demonstrates that in the specific context of developing and implementing educational innovation – fundamentally a question of creating allies and partners (Akrich et al., 2002) – silence served a performative function in establishing, strengthening and managing interdependencies and encouraging the collaboration needed for realizing desired change.

Silence was relevant at two distinct strategic levels: for creating an external stakeholder environment beneficial to developing the programme, as well as for guiding the internal decision-making process. First, silence is used purposefully when the risks of communicating verbally about an issue outweigh the benefits of its resolution or when scientists do not want their plans to leak out prematurely.

Exchanging knowledge and information, and engaging in dialogue with powerful parties who seek to influence or pull projects towards them- selves, are generally seen as defining aspects of innovation processes (Akrich et al., 2002; Leeuwis & Aarts, 2011). Yet, despite the value of verbal communication, talking with others may not always have the desired effect; sometimes innovations are simply too complicated, controversial or under- developed to share with, or sell to, specific parties. Openly addressing issues or confronting a conflict would politicize plans or cause them to be misunderstood and to fail. Silence can take attention away from an issue, protecting and developing plans that are prone to the turbulent culture of bargaining and that still need to gain legitimacy (Bok, 1989). In the meantime, visions can be sold to enough relevant actors to build momentum and ensure that resistance can no longer appropriate or sink ideas or projects.

In addition, silence plays an important role in guiding the internal decision-making process between actors who already recognize and underwrite the value of proposed innovations. Although people purposively choose to collaborate (Knight, 2002), this creates its own specific challenges and dilemmas: people have to meet and discuss ideas with others they may never have worked with before and with whom they may disagree professionally, or whom they do not yet fully trust (Shrum et al., 2007). In order to co-construct the process of innovation, they constantly have to make compromises that justify everybody's views and interests. This requires silence, as when one chooses to communicate a certain topic while avoiding many others in order to leave room for alternative ideas but also to obstruct further questioning of complicated issues and to make it possible to work out short-term agreements.

As Shrum et al. (2007) have observed in relation to multi-organizational scientific collaborations, scientists manage interdependencies by circumventing potential disagreements, abandoning arguments and confrontations until later. As the authors write: 'They define regions of silence, about which they will not talk. They emphasize the shared goal and not the differences in preferred means' (ibid.: p. 175). In our study, actors constantly had to balance day-to-day versus longer-term goals, turning away from sensitive issues and debates that touched upon professional differences in order to get the programme up and running. As such, silence made it possible for diverse ambitions, perspectives and interests to work towards and exist next to each other (Nussbaum, 2006).

The above indicates that silence serves an important strategic function in different contexts of the innovation process. However, we have also pointed to its unintended consequences for the course of interaction, both at other sites in the network and in the long term. First, silence substantially influences how the meaning of innovation is co-constructed in different sites and networks. Scholars have noted that what is talked about in conversations produces further communications, for example because participants take what has transpired in one context and discuss it in another context (Ford, 1999; Krippendorf, 2008). Extending this argument, we suggest that what is not said in one interactional setting is also likely to affect how people talk – or don't talk – about things in another setting, frequently in unexpected and undesirable ways. Keeping the programme out of the spotlight and leaving long-term issues off the table and unresolved, while productive in the decision-making context, caused plans to remain largely invisible and unaccounted for on the work-floor level. This resulted in problems and dilemmas for domain experts who lacked the authority to frame dialogue in such a way to convince departmental heads and teachers of the programme's importance, at times igniting undesirable resistance (Ford, 1999). This indicates that silence in one part of the network can shift the problem elsewhere, causing previously silenced interpretations and voices to emerge and influence the course of the process in undesirable ways (Van Assche & Costaglioli, 2012).

This also has consequences for the co-creation of innovations in the long term. Uncertainty about the programme's meaning led to problematic working routines for those who were trying to make others see its value from their perspective. Previous studies pointed out how the failure to address certain issues can lead to operational problems and behaviour for those who already have a very high workload (Dörner, 1996; Henriksen & Dayton, 2006; Tucker & Edmondson, 2003). In their qualitative study of the internal supply chains of hospitals, Tucker and Edmondson (2003) found that nurses were reluctant to speak up about perceived problems or to ask for help, and instead quietly adjusted and corrected mistakes without addressing the core of the problem itself. This resulted in complex working routines that took valuable time away from patient care. In our study, silence also led to time-consuming and counterproductive activities for domain experts, who had to work with a poorly designed programme and had to engage in uncomfortable communicative situations. From this, we are able to understand how people become less motivated to commit themselves to innovation over time. Failure

to talk about changes in a productive manner causes people to become anxious and cynical about proposed changes (Morrison & Milliken, 2000), resulting in a decreased feeling of attachment towards it.

This chapter has offered insights into the role of silence in an academic educational innovation, arguing that fully grasping such processes requires understanding of both silence and verbal communication and their dynamic interaction across various interactional contexts. Conceptualizing silence as an active part of the educational innovation process helps show why it is difficult to connect actors around innovation (Akrich et al., 2002; Van Bommel et al., 2011). For innovation to become meaningful, it must be developed and implemented in different 'micro' settings, but at the same time it needs to become contextualized and anchored within a wider network (Akrich et al., 2002; Nicolini, 2010; Ford, 1999). In such conflicting contexts, silence can provide productive solutions for many context-specific contradictions and tensions, but will unavoidably create new problems in the bigger picture – sometimes very directly, sometimes indirectly, but always preventing structural changes that are needed for innovation to become accepted in the wider net- work. Silence is thus simultaneously a precondition for, and a limit to, this interaction (Luhmann, 1994). This, it seems to us, is also indicative of the consistency of silence with the paradox of innovation (Fonseca, 2002). The more people rely on silence to carry out context-dependent plans and actions, the more their silent behaviours will cause that interaction to become even more complex and uncertain.

While we have offered initial insights into these complex issues of silence in the context of educational innovation, further empirical research is needed to deepen the insights provided by our single case study. In particular, our exploratory study serves as an invitation for other researchers to identify and distinguish more subtypes of silence and their consequences for developing and implementing academic innovation. With academic institutions increasingly looking for scientific innovation, this seems to be a productive avenue for generating the insights needed to create and sustain meaningful interdisciplinary projects around important socially relevant themes.

As for its practical implications, our study provides a powerful framework for thinking about the steering of processes of innovation. In designing for innovation, scientists, academic institutions and policy makers need to take into account that change is constructed in and through communication (Ford, 1999) and that

not saying things – remaining silent – is a crucial aspect of this process. As we have pointed out, silence has to do with uncertain and constantly changing interactions and interdependencies, which makes it difficult to predict in advance where and when silence will occur, and how and where it will affect connections in the process. This means that silence must be appreciated as a 'natural', inescapable and sometimes necessary part of the messy and unpredictable course of innovation processes. That said, we do think that innovation processes will benefit from involving people who can adequately monitor and address moments of silence and talk and their dynamic interrelation across disciplinary and/or institutional boundaries. We clarify this point by returning once more to our case study.

Despite the bumps along the road, the programme was delivered on time in September 2014. Naturally many things contributed to this, among them the hard work and persistence of some of those involved, positive assessments and the accreditation of the programme. In addition, we would also like to emphasize the importance of putting a domain expert from the technical university formally in charge of the delivery of the programme. Making someone responsible for the process served as a catalyst for encouraging interaction and communication between diverse actors and parties. Under this person's guidance a vision document was written, participants from the three institutions were more actively approached and informed, and work- shops were organized in which outsiders were invited to share experiences about developing similar programmes. This all helped to pull the network together. As one of our informants told us:

> 'You really need someone who keeps control over the process, even when there are bumps in the road. Someone who can give direction. ... All those people are inclined to make decisions from their own field. Protecting the lines is crucial. If you do not do that you have a wheelbarrow full of frogs that jump in all directions.'

It goes without saying that a single person can never control or determine the success or failure of complex interdisciplinary projects such as described in our study. Complex innovations are dependent on the interplay between different actors or interest groups within a network, taking into account their competing interests, wishes and dreams. Nevertheless, from a conversational management perspective (Ford, 1999), we would argue that the process still benefits from including a

person who can monitor the quality of conversations needed to connect relevant contexts during all stages of the process and can effectively move between these different contexts. This requires someone who under- stands the rhythm, melody and harmony of the interplay between silence and talk in institutional environments; someone who can 'spread the story' by clarifying or defending ideas where and when necessary, encouraging people to openly discuss developments and concerns in a productive way while being attentive to their status and interests, but who also recognizes the limits of conversation and knows when it is necessary to remain in the background, and thus, stay silent.

04

COMMUNICATION AND SOCIAL LEARNING: THE SIGNIFICANCE OF SILENCE

ABSTRACT

Complex societal problems require collaboration between many actors with difference background, perspectives, and interests. The chapter starts from the premise that constructively engaging in these collaborative efforts requires social learning, and that the need to learn collaboratively in groups, teams, or networks draws attention to the communicative processes through which parties come to recognize, discuss, negotiate their differences. In this conceptual chapter, social learning theories are specifically discussed form the perspective of silence. Silence is introduced as a neglected, but crucial dimension of the communication process. The chapter gives a brief overview of functions and meanings of silence, which are than explored with regards to content, relationships, and process-related dimensions of social learning. Silence, it is illustrated, creates multiple opportunities and constraints for social learning, and a better appreciation of its dynamic interrelation with verbal modes of communication can help both teachers and science communication professionals navigate complex learning contexts and engage in constructive collaborative problem solving.

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Introduction

Current reforms in both school and universities call for joint problem solving around social issues. Both teachers and scientists must collaborate extensively with relevant stakeholders inside and outside their institutions to address these complex social challenges: school teachers have to develop new course material in consortia of teachers, obtain money from school management, engage with growing parent involvement, and work closer with groups like local community, businesses, colleges or universities to strengthen school programs (Daly, 2010; OECD, 2003). Comparably, scientists must collaborate with colleagues from different disciplinary fields, liaise with policy and management staff, and build dialogue with stakeholders from government and industry. Despite the obvious advantages of cooperatively confronting problems, there are barriers of many kinds: people have to synchronize their activities; they may not 'speak' each other's professional languages; or have different or even colliding interests. A noted problem in the schooling context for instance is that both teachers and parents have problems understanding each other's roles (Epstein & Sanders, 2006), while collaboration between scientists is notoriously difficult when this involves working across disciplines towards a common goal (Jeffrey 2003; Katz & Martin 1997).

In this chapter, the course of collaboratively solving complex problems is explored by connecting social learning and communication theories. In general, solving complex problems in highly dynamic and interactive environments requires that diverse groups and teams, communities, and networks of actors constructively engage in collaborative learning processes (Aarts & van Woerkum 2002;

Wenger 2000; Bouwen & Hosking 2000). In a policy context, social learning has emerged as a response to the failures of instrumental and hierarchical modes of policy development that emphasize direction and regulation (Pahl-Wostl et al., 2007). In contrast to these approaches, social learning emphasizes the interactive and collaborative nature of these processes, and conceptualizes policy development as human activity that takes place 'in rich social contexts with innumerable vantage points, interests, values, power positions, beliefs, existential needs, and inequities' (Wals & van der Leij, 2007, p. 18). Social learning is considered a key mechanism for interactive or participatory problem solving and arriving at more desirable futures (Leeuwis & Pyburn, 2002).

The course of constructive social learning requires communication (Gherardi & Nicolini, 2002; Isaacs, 1999; Wenger, 2000). Through talking productively about the realities they know (Ford, 1999), people come to recognize and respect each other's perspectives and positions, helping them to integrate their differences and interests in collective solutions (Aarts & van Woerkum 2002). This idea is not new. Many communication scholars have shown that, in order to interactively solve complex problems, parties must recognize, discuss, negotiate their differences. For the purpose of this chapter, I want to explore the idea that social learning rests on silence at least as much as it does on exchange and conversation. Despite promising literature on silence in other research areas (Ben-Ze'ev, Ginio, & Winter, 2010; Jaworski, 1993; Krieger 2001; Van Assche and Costaglioli, 2012), its significance for the area of social learning has not yet been the explicit focus of research and theory. In this conceptual contribution to this book, I will therefore explore silence as a crucial feature of social learning. I address the dynamics of silence and communication in complex interactional situations, and the ways silence both positively and negatively shapes the capacity to solve complex problems collaboratively within groups and networks.

The exploration is commenced by briefly clarifying the concept of social learning and its relation to verbal modes of communication. Then several forms and functions of silence are explained, drawing on research from a variety of disciplines and research that has examined its relevance for social interaction (Basso 1970; Ephratt 2008; Krieger 2001; Jaworski 1993). In the second part of the chapter, the relevance of silence will be explored more specifically with regards to the concept of social learning, focusing on the content, relationships, and from a process-related perspective of social learning. In the conclusion the implications our

exploration has for understanding and facilitating future social learning endeavours in educational and scientific contexts are outlined.

Social learning: issues, relations, and process

The essence of social learning is that diverse actors interactively work towards acceptable solutions for complex social issue or problems. In the social learning process, three main challenged have to be addressed.

First, critical evaluation and examination of different ways of perceiving and assessing the issue or problem at stake is needed. Specific kinds of knowledge and expertise have to be shared, combined and integrated to arrive at a joint solution. This involves reflection on the taken-for-granted theories, beliefs and assumptions (Jacobs & David 2005). Put differently, social learning requires that we pay attention to the content of what is being discussed.

Second, social learning necessitates the building of constructive relationships that can support attempts at finding joint solutions. Bouwen and Hosking (2000) assert that the reflexivity of the parties depends on how the enactment of existing relationships occurs. Social learning always means a bridging of communities and requires an awareness of relationality. Giving explicit attention to this relational dimension of social learning, Wenger (2000) explains how learning involves the constant interaction between members of a bounded community of practice, which is founded on familiarity and confidentiality, and members from outside of the community which bring along innovative knowledge and expertise and prevent the group from becoming self-contained, defensive and oriented towards its own focus. Because social interaction thus requires interactions within and across groups, Wenger gives special attention to the concept of boundary in his theory. Boundaries provide spaces where perspectives meet and new ideas thrive

and where learning is ignited, but the challenge of crossing boundaries and engaging with others creates uncertainty and can threaten 'modes of belonging'. For Wenger boundary practices are therefore interwoven in profound ways with our professional identities. The lived experience of interacting across boundaries creates concerns about identity, and how participants perceive themselves and those with whom they identify. Their identities significantly determine how they engage in boundary interactions, shaping their willingness with whom to interact (Jacobs & David 2005; Gherardi & Nicolini 2002; Wenger 2000). Social learning therefore also asks us to reflect on the interdependencies between interacting parties involved in the learning process.

Third, a constructive social learning process requires that the interactional process itself is accommodated in such a way that learning is facilitated (Leeuwis & Pyburn 2002). Favourable conditions are needed that set the contours of interaction during the interactional process, which requires that there are enough opportunities for joint activities (platforms, workshops, forums, meetings), actions and events are aligned with other processes within the network (for instance through informational exchange), and that the successful development and implementation of plans and strategies is guaranteed (maintenance of creativity, momentum, progress) (De Bruijn, Heuvelhof & Veld; Van Assche & Costaglioli, 2012, 2010; Wenger, 2000). Requirements for constructive social learning thus involves an analysis of how parties construct the wider interactional process.

From the above, social learning can be seen as entailing a complex balancing act: it involves the exploration and integration of distinct perspectives and understandings, connecting the rights parties around the problem or issue at stake, and organizing and implementing productive interaction moments for their actual exploration.

Communication is crucial for realizing these objectives. Both classic and recent approaches underline the discursive dimensions of social learning in organizational settings and contexts, teamwork, and networks stressing the importance of learning conversations (Baker & Jensen 2002; Bouwen & Hosking 2000), active dialogue (Isaacs, 1999), and storytelling (Bate, 2004). Numerous examples are found in the literature illustrating how communication fulfils the role of linking ideas, relations, and processes. According to Isaacs (2008), for example, talking with others enhances reflection on preconceptions, expectations, and judgments, leading to the integration of different kinds of knowledge. Similarly, Oswick et al.

(2000) recognize communication's capacity to bridge between individual understanding and collective outcome. Dialogue, they write, 'reflects the meandering, hazy and complex way in which the gap between individual and organizational learning is actually bridged and through which deeper plurivocal insight is created' (p. 899). Wenger (2000) also presents communication as an integrating mechanism in social learning, pointing out how a common language allows people to communicate and negotiate meanings across boundaries.

Open verbal exchanges are essential for establishing relationships and creating group identity. By telling and retelling stories people get to know each other and construct shared meanings and understanding that can bind a group of individuals into a community (Bate, 2004). Gherardi and Nicolini (2002) explain that discourse fosters learning by exploring and comparing the perspectives of all the co-participants in a practice. Focusing on the barriers towards learning, other scholars demonstrate that communication in not necessarily something that brings people closer together or aids in problem-solving, but can lead to incomprehension and the creation of new problems and conflicts (Aarts & van Woerkum 2002). Taking the risk of not doing justice to the differences between approaches here, we want to stress that most of these scholars agree upon the relevance of verbal communication for learning processes.

Despite the valuable insights produced by existing studies that explore the link between communication and social learning, these studies overlook the significance of silence for social learning. Even though most of these authors recognize that silence is significant, they mention in only in passing. Gherardi and Nicolini (2002) mention that social learning theories 'fail to describe how knowledge remains isolated and not communicated from one community to another' (p. 42). Despite such indications of the relevance of silence in social interaction, scholars have not explicitly addressed its significance in the context of social learning. In the rest of this chapter, I therefore wish to draw attention to silence, exploring its significance in relation to the three components of social learning explained before: content, relations, and process. However, before doing this, it is useful to first look at what exactly is meant by silence.

The concept of silence

In this section, I take a closer look at the concept of silence, after which I will bring the discussion back to the notion of social learning. At first sight, the importance of silence for our social interactions may seem obvious. Most people know by intuition that silence is an intrinsic part of their lives, they often associate it with simplicity, contemplation, rest and solitude. However, the idea that silence is also constitutive of complex social processes is often less obviously recognized. When silence is addressed in the organization, it is often seen as an absence, as something that indicates that which is not currently present. Several scholars have pointed out that silence is commonly taken as the opposite of speech and meaningfulness and receives little attention (Pinder & Harlos, 2001).

Recent literature, however, illustrates that silence interacts with language functions of communication and that both shape each other. Using a phenomenological perspective, Dauenhauer (1980) explains how silence supports human language in several ways, drawing attention to the silences that intervene words, phrases, and sentences, and the fore and after silences that terminate utterances and make them distinct from each other. Intervening silences for instance are the spaces that punctuate words and sentences in order to create meaning in written texts. Silence makes texts readable by focussing the reader's attention on the content. Silence also serve this function in other social contexts. An example is a comedian's telling of a joke. 'The silence before the punchline commands the audience's attention, stops what could be a monotonous flow. Without this silence, the joke could fall flat' (Krieger, 2001, p. 216). Another example is the use of silence to accentuate suspenseful or dramatic science in a movie. Coulthard writes: 'In terms of film sound, silence is relative, a constructed and fabricated effect of silence rather than any true entity or quality or even absence' (p. 21).

Beyond its function as a means for structuring communication, silence marks the limits of what can talk about. Silence is for instance often associated with the failure of language to express extreme emotional pain as in trauma, communicate devastating emotions created by disaster or war (Wajnryb 2001), or talk about skills or experiences that cannot literally be spelled-out (Blackman 2009). In this regard, Van Manen (1990) writes that beyond the range of our speaking and writing there is a rich domain of the unspeakable that constantly beckons us (p.113). We run out of things to say when we experience unspeakable or ineffable situa-

tions in life like amazement or death. Van Manen furthermore mentions that this type of silence is never absolute. According to Van Manen (1990), what is beyond our linguistic competence and capacities can often be put into words by another person; by someone who has a special writing skill such as a poet, philosopher, or author of fiction. An experience of the inexpressible may also be expressed in another discourse; the language of poetry for example is better able to describe a topic like love than behavioural sciences. Things that are unspeakable may finally be captured in language at other, more suitable moments, as when we surprise ourselves when we unexpectedly put things in words that we thought were beyond our grasp.

While the above research makes us attentive of the silences that cannot be spoken because issues are too intense, complex, or overwhelming to be put into words, interactional theory provides a further approach to understanding silence, exploring it as part of the social order (Argyris, 1980; Jaworski, 1993; Goffman, 1981' Morrison & Milliken, 2000). Silence is placed in the context of processes of socialization of individual members into society or a group. In *Forms of Talk* (1981), Goffman identifies silence as a form of respect we owe in a social situation to others that are present. He writes:

> In holding our tongue, we give evidence that such thought as we are giving to our own concerns is not presumed by us to be of any moment to the others present, and that the feelings these concerns invoke in ourselves are owed no sympathy. Without such enjoined modesty, there could be no public life, only a babble of childish adults pulling at one another's sleeves for attention (p. 120).

Silence is thus included in the interactions, alignments and positions of individuals vis-a-vis one another. In his oft-cited work *The Power of Silence*, Jaworski (1993) also firmly places silence within interaction, showing how silence always has meaning in social situations where communication between people is expected or required. Jaworski reveals how silence allows for preserving self-respect and managing harmonious relationships, for example by avoiding unwanted imposition, confrontation, or embarrassment in social interactions.

Additionally, there are things that are generally known but are not publicly spoken or articulated (Croissant, 2014; Geissler, 2013; Zerubavel, 2006). This

approach to silence suggests that there are some things that are open to experience but are collectively kept silent in public affairs and debates. These silences are commonly referred to as conspiracies of silence, which are described by Zerubavel (2006) as 'collaboratively upheld endeavours that presuppose mutual denial in which at least two people collaborate to jointly avoid acknowledging something' (p. 20). Silence is approached as a social contract that ensures that an unspoken consensus prevails about what can and cannot be spoken or discussed in public. Conspiracies of silence occur in nearly all social systems amongst which families, organizations, and communities and examples are countless, one can think of silence about child abuse in the Church, about torture in war situations, or the denial of gay soldiers in the army. Conspiracies of silence are also very persistent. Zerubavel explains that concerted efforts to ignore the elephant in the room may ultimately permeate every aspect of the relations among co-conspirators of silence. This is exemplified by the fact that silence breakers like whistle-blowers are often ridiculed, vilified, and often ostracized.

In addition to conspiracies of silence, there is a category of things that is not spoken because it is taken for granted or self-evident. Bourdieu (1977) refers to these silences as social because 'what is essential goes without saying because it comes without saying'. Social silences are not collective attempts at avoidance of discussing something, but less deliberate silences that emerge from shared ideological assumptions and common-sense understandings. Tett (2010) gives an insightful example of the social silence that surrounded credit derivatives. The fact that the operations of the financial world were perceived as extremely technical and dull made it uninteresting to non-specialists such as policy makers, with the result that financial patterns were simply taken for granted. Tett explains that this lack of scrutiny and accompanying silence about the banking world was intrinsically ideological and ultimately served the interests of the bankers. Social silence sustains ideology: 'The most successful ideological effects are those which have no need of words, and ask no more than complicitous silence' (Bourdieu, 1977, p. 188).

Finally, there are things that are not spoken because they are forbidden or prohibited. This can be explicitly through censorship, as is the case with people or groups who are physically silenced, ignored, or precluded for instance by state-sponsored violence (Olsen, 2003), or silence as cultural censorship that is

practiced in the absence of explicit coercion or enforcement such as the silence surrounding the subject of racism (Sheriff, 2000).

There is thus a diverse scholarship that distinguishes different manifestation, forms and functions of silence in social interaction. While a complete review of the literature on silence is outside the scope of this paper, it is clear that that silence and verbal communication are not opposites, but interact and reinforce each other. Following this line of thought, I will now explore the concept of social learning from the perspective of silence. Throughout the rest of the chapter, I will examine the significance of silence in relation to the content, relations, and process aspects of social learning discussed previously. In this, I follow Morrison and Milliken's (2003) call for getting a better understanding of when silence is functional, harmless, and when it is dysfunctional or even destructive.

Silence with regards to content, relations and process

Silence with regards to the content of social learning

I first discuss silence with regards to shaping the issue or problem at stake in social learning. As mentioned earlier, social learning requires that diverse actors interactively work towards acceptable solutions for complex social issue or problems, which requires that they share, exchange, and integrate different kinds of knowledge. At the beginning phases of collaborating, individuals usually have separate ideas and perspectives about how to address and solve these problems. Finding common ground between distinct idea and approaches entails critical reflection and profound engagement with assumptions and perspectives. This requires putting taken-for-granted perspectives aside. Through open and honest communication people come to experience their realities as constructions, giving them the opportunity to examine underlying predispositions that determine ways of seeing, thinking, talking and doing (Ford, 1999). Isaacs (1999), similarly, asserts that the ability to talk and think together in productive ways is a vital source of competitive advantage and organizational effectiveness in the new knowledge-based, networked economy. In dialogue, people create, refine, and share knowledge through conversation allowing for innovative ideas, perceptions, and understanding to surface (Isaacs, 1999, p. 2). Through productively communicating with each other, parties come to recognize how their own actions contribute to the problem, reconciling separate perspectives and developing shared conceptualizations of the

problem (Aarts & van Woerkum, 2002). The failure to engage in the right type of conversation can, on the other hand, be a reason why people are hesitant to accept new solutions, feel that previous solutions will no longer work, or become cynical about problem solving (Ford, 1999).

While verbal styles of communication are critical for constructive social learning, there are also notable examples of situations in which silence is a notable feature of the exchange between experts. In their analysis of the tragic Challenger launch of 1986, Vaughan (1998) explains how people who had relevant information that might have altered the outcome remained silent. Persons who feared for the worst said nothing, and kept their insights to themselves. Gardezi et al. (2009), in their study of interprofessional teams in the operating room, also show how nobody said anything when patient safety was at stake. Some issues or problems are thus never cast in language.

Silence about contentious issues

Why do people remain silent about agenda items, events, discussions, or problems concerning that require discussion to be solved? The literature gives several reasons such silences. Berger (2004) suggests that people may unintentional refrain from talking about complex topics in social situations because they do not know what to say at the conceptual level or are unable to find the right words to express themselves. In discussions about complex problems, people may also stay silent because they feel they cannot capture the finesse of complex social or technical issues in words, or because they do not have the communication skills to address complex topics adequately with others (Gendron, 2011).

Other organizational scholars approach silence in terms of how actors remove uncomfortable or contentious issues from open discussion. Most individuals, according to Argyris (1980), behave using Model 1 theories that limit their capacity to learn in organizations or teams. Model 1 theories involve the simple detection and correction of errors, and fail to explore inconsistencies or contradiction that go underneath taken for granted norms, policies and objectives. For Argyris silence is closely linked to Model 1 learning where it serves the purpose of ensuring that these discrepancies that question their knowledge and expertise do not have to be openly discussed. This requires two consecutive practices. On the one hand, people must conceal these inconsistencies by covering them up, for instance by rejecting rapports or bypassing information. However, distorting

information is not enough. People must also find ways to ensure that the activity of concealing is itself concealed, and that issues and problems are not available to awareness and cannot be brought into communication. Argyris explains that the actions that produce the errors must be made undiscussable and their undiscussability must be made undiscussable. This double process of concealing makes people 'blind to what they are doing and blind to the fact that they are blind' (p. 209). Silence hence sustains a certain way of talking about problems and issues, drawing a sharp boundary between what people can explicitly talk about and what needs to remain unsaid.

Other organizational scholars have tried to differentiate between various forms of organizational silence. Pinder and Harlos (2001) offer one of the first comprehensive approaches to employee silence claiming that people consciously do not talk about relevant ideas, information, or opinions that can influence organizational performance. They distinguish between quiescent and acquiescent forms of silence. The notion of acquiescence refers to the state of involuntary or passive withholding of relevant ideas or opinions about one's own work because of the feeling of resignation. Alternatively, quiescence means that one does not agree but stays silent because of fear of negative outcomes. An example of the latter is the 'mum effect' which arises when people postpone communicating bad news because they fear personal discomfort or defensive responses from the recipients of information (Rosen & Tesser 1970). Dyne et al. (2003) have extended the quiescence/acquiescence dichotomy adding the category of pro-social silence that they describe as "withholding work-related ideas, information, or opinions with the goal of benefiting other people or the organization – based on altruism or cooperative motives" (p. 1368). Pro-social silence is a type of intentional and proactive behaviour that stems from not wanting to hurt or damage colleagues or the organization more generally, rather than from personal motives, for instance when we keep silent to ensure that colleagues will not be harassed or discriminated.

Morrison and Milliken (2000) mention the withholding of voice as a key element of silence, but stress its collective rather than individual character. They explain that employees often remain silent en masse when confronted with uncomfortable issues like pay inequity, disagreements about policy, personal career issues, ethical issues, and conflicts with colleagues, evocatively applying the elephant in the room metaphor to depict the deliberate nature of collective organizational silence: 'Imagine an organization where the CEO has no clothes.

The CEO's lack of clothes is apparent to all who set eyes upon him or her. Yet employees never mention this. ... Behind the safety of closed doors and in veiled whispers, they talk of their leader's lack of clothing. They all clearly know that the CEO is naked, but only the foolish or naive dare to speak of it in public' (Morrison & Milliken, 2000, p. 706). According to Morrison and Milliken, silence results from forces within the organization, employees do not express their ideas and do not speak the truth out of fear of negative repercussions or because they believe that their opinions are not valued. Silence can furthermore be triggered by people's fear of being perceived negatively or being labelled a 'difficult person' or 'not a team player'.

Additionally, silence may be applied openly for strategic reasons by individuals or group to influence the issue or problem under discussion. Brummett (1980) mentions with regards to political discourse that strategic silence 'violates expectations, encourages the attribution of certain meanings, and is directional. Behind these characteristics lies the assumption that silence, like any political action, must be intentional to be strategic' (p. 23). Unlike the silences used to protect oneself or others, silence is strategically applied so that specific issues or problems do not have to be addressed in order to further one's own interests, for instance when political leaders refuse to communicate verbally about certain issues or problems despite public expectations (Brummett, 1980).

A wide range of functions can thus be identified in uses of silence insinuations where talk is required about substantive issues. Each of these silences influences social learning in its own way. When used to enhance reflexive inquiry into issues and problems that need to be solved for social learning, silence can create communicative exchange between actors and parties that serves the 'purpose of reflection, rest and re-thinking' (Star & Bowker, 2007. p. 279). In dialogue, silence is an essential quality to suspend judgment and to reflect about issues or problems. Silence may for instance give the speaker time to think and the hearer time to listen and apprehend. A couple of minutes, days or even weeks apart can give parties time to contemplate and better comprehend their own perspectives and those of other's and approaches. Krieger (2001) explains that lengthy interactive silences 'can give both sides the chance to reflect on the merits of the different proposals, to consider the arguments given, and to develop a response' (p. 221).

Constructive uses of silence for creating openness and reflection must be distinguished from those silences that prevent close scrutiny of problems, thus

reducing reflectivity. Here, silence undesirably influences social learning, reducing collective reflection on potentially valuable perspectives and approaches (Milliken & Lam, 2006). Rather than talking about their opinions and perspectives during meetings intended for strategic deliberation and reflection, people stop sharing ideas and concerns, blocking out negative feedback and creating a distorted image of the information on which decision making is based (Hewlin 2000; Morrison & Milliken, 2000). Moreover, silence is likely to lead to op the spot problem solving and concrete quick-fixes without talking into account long term issues and complex workings of systems that require exchange between expertise (Dörner, 1996). In this regard, Perlow and Repenning (2009) have shown how silence can become a timesaving strategy that is used to speed-up working processes. Staying silent about the time-consuming issues creating an atmosphere conducive to rapid decision-making, it at the same time leads to prioritizing or postponing certain issues and problems. This can have far-reaching implications for social learning because issues that need extensive deliberation are turned into consent.

The above has shown that silence has diverse forms and functions with regards to how parties address the problem or issue at stake: silence is used to conceal awkward or contentious issues by making them undiscussable, to avoid negative outcomes deliberately, or to strategically manipulate problems and issues. Considering its consequences for social learning, it was furthermore indicated that silence can both facilitate and obstruct the transfer of knowledge and influence critical reflection, all depending on the context.

Silence with regards to relational dimension of social learning

Thus far it is argued that silence, in addition to speech, plays a crucial role in how perspectives and understanding are integrated and combined. As previously mentioned, solving complex problems also means that constructive relationships between familiar partners and relevant others must be created and sustained. Communication is widely indicated as having a critical role in this process, determining how people construct their sense of belonging and identify with others.

In their book *Moral Conflicts*, Pearce and Littlejohn (1997) address this issues and write that 'all human beings use language to establish a sense of self and

other, to define the boundary, and to create some sort of orientation toward others' (p. 108). How people communicate significantly determines how they deal with differences and commonalties, shaping practices of inclusion, exclusion and group cohesion. In considering the role of silence in creating relationships, this section specifically looks at its role in the activities of in-group bonding, inclusion and exclusion of relevant others, bridging between socially heterogeneous groups, and conflict management.

Communication is commonly used by parties to recognize and strengthen their similarities. Each group develops specific communication patterns, which influence who talks to who about what, which makes it possible to connect people to the 'we-group' (Pearce & Littlejohn, 1997). The construction of the commonalities, however, depends on more than words alone. Silence is equally important for ensuring that closeness and proximity between people is achieved (Krieger, 2001). Through words people create shared meaning and establish connections between themselves and others. Once these connections are in place further discussions about issues or topics are often perceived as unnecessary, and may be experienced as intrusive in the relationship because they disrupt the harmony (Krieger, 2001). Consider for instance how silence provides a basis for intimate experiences between close friends or lovers, through the absence of words they orient themselves towards each other and express their solidarity and closeness, creating a bond that is often stronger than shaped through words.

The capacity of silence to create a bond between people is addressed in the literature on secrecy. In *Das Geheimnis und die Geheime Gesellschaft* (1906) Simmel identified secrecy as being at the foundation of how humans built relationships and construct group identity. According to Simmel, secrecy is a sociological expression that determines the reciprocal relations between people who share the secret. The ability to preserve secrets through the obligation of silence lets them create a 'we-feeling'. In *Nuclear Rites*, Gusterson (1998) gives an illustration of this bonding function of secrets. Investigating a top-secret nuclear weapons lab, Gusterson shows how secret information is a defining element in the construction of expertise and professionalism of scientists working in the lab. Restricting the sharing of classified information with outsiders and joining in silent practices creates a strong bond between scientists and forms the basis of their identity as authoritative 'experts'. In the case of social learning, this use of silence to create a 'we-feeling' can be very useful. It establishes deep connections between those who share

the same histories and experiences, conjuring feelings of belonging and of being engaged and included so forming the basis for learning experiences.

Alternatively, when silence is used to create a strong bond between people, individuals may become hesitant to share their ideas and views with relevant people or parties outside of the group. In her work on Holocaust survivors, Wajnryb (2001) illustrates how silence can have two-faces, on the on hand binding holocaust survivors through the incommunicability of the shared trauma, on the other making it extremely difficult to talk openly about their horrifying experiences with family and close friends who have not been through the same experiences. As Wajnryb (2001 writes, 'the insider– outsider exchange is haunted by the belief that the trauma being unshared cannot be communicated' (p. 97). While silence can thus draw people together in a shared experience, it can concurrently form a wall around them that goes at the cost of exchanges with relevant others who do not share the same experience. This failure to articulate and talk about experience with relevant others becomes particularly dysfunctional when the feeling that the outside world does not understand them grows, and people begin to cherish and protect their experiences, relying on each other not to talk about issues that threaten group solidarity. Silence, then, becomes a protective shield for the 'we-group', creating a situation closes people to exploration and external input. Eventually this can cause those people to lose contact with the outside world.

Turner and Pratkanis (1998) describe this process of self-preservation as groupthink in which group members attempt to maintain a shared positive view of functioning of the group in the face of threat. This process of self-preservation is captured in recent studies that deal with the 'blue code of silence' in the police force, which prevents police officers from testify against other officers about misconduct. Chambliss (2011) explains this with regards to the policing context which places contradictory demand on police officers, who have to enforce law and order on the one hand, and have to work in life-or-death situations and at legal and ethical boundaries, on the other. Because of this policing culture also attracts hostility and criticism from the public, which has very little insight into police work. Carrying out this uncertain and dangerous work makes police officers very dependent on each other. A degree of silence is necessary to ensure the trust and safety that is needed to perform their work efficiently. Chambliss furthermore clarifies that the code of silence isolates the police force from the rest of society, making police officers cling to their self-identity. As this example shows, although silence may

initially serve as a survival strategy, it often accomplishes the opposite by creating intense in-group dependence and sealing of all communication with the outside world.

In addition to including and excluding, silence influences how differences between parties are explored and examined, and how connections with relevant others are built. Basso notes that when strangers meet for the first time, silence can be preferred over talk when establishing fragile relationships. Silence is the appropriate behaviour for meeting strangers and foreigners because it shows politeness and respect for others. An example of this is when we keep silent in order to listen to others during conversation. Jacobs and David (2005) explain that listening involves more than simply processing information; by listening to others we acknowledge and respect what they stand for and have to say and constitutes a relation between speaker and listener. In the context of social learning, silence, as a form of respect, is useful because it lets people with different backgrounds approach to each other without having to put their identity on the line immediately, so creating further opportunities to talk productively about differences and similarities. Differences are thus acknowledged without creating more distance between parties.

Alternatively, silence may be used to signal that the relationship is in distress without having to put this into words or engage in verbal confrontation, as when someone ends a letter correspondence, does not reply to an email request, or does not answer the phone. This withdrawal of words can be a calculated strategy to reprimand someone who relies on verbal interaction within a relationship (Olsen, 2003). For example, by giving someone the 'silent treatment' we try to exclude him or her from the conversation. In politics, silence is often seen when the mainstream parties have to deal with populist politicians who voice oppositional or intolerable points of view. Rather than seeking verbal confrontation, they are often deliberately negated in an attempt to place them outside of the discussion and restrain their power. Creating such a cordon sanitaire around individuals or groups may exclude these people from their sphere of engagement, but also erects silent boundaries between parties making differences discussable. This creates a major obstacle when positive relationships need to be established and maintained for social learning.

Pearce and Littlejohn (1997) furthermore explain how communication is used for the management of relational tensions, for example explaining how parties

use rhetorical strategies such as persuasion, argumentative reasoning, and bargaining to negotiate potential conflicts. In such situations, the use of silence can serve the purpose of bridging between differences. Ferguson (2003) explains, 'In silence, as in few other mechanisms, individuality, incommensurability, and community coexist' (p. 63) When heterogeneous groups need to be connected around a common goal, silence keeps tensions to a minimum and potential conflicts off the radar thus protecting fragile relationships. Silent diplomacy is for instance used in political negotiations where openly addressing differences and incompatibilities is likely to lead to cumbersome and painful discussion. Strauss (1978) draws attention to this bridging function of silence, explaining how 'some negotiations may be very brief, made without any verbal exchange or obvious gestural manifestations'. Even though negotiations do not involve a lot of talking, Strauss notes, parties are perfectly aware that they are involved in making an agreement. All parties accept a 'pact of silence' covering up differences in such a way that it suits their agendas and interests. Peace-building initiatives, in which silence lowers the 'temperature' of on-going disputes and creates the possibility to let the wounds of the past heal, are a good example of this.

Winter (2010) discusses silence in the context of formal and public inquiry into atrocities committed during Franco's dictatorship became a strategy accepted by all parties after the civil war to ensure the success of a peaceful transition to democratic rule. Silence kept painful issues off the radar, ensuring that fragile social and political relationships between different parties were maintained. Talking about the issues would likely have signalled termination of communication or contact. Silence thus fulfilled a bridging function making it possible for parties to live with and tolerate their differences and incompatibilities, and work towards a new future.

Silence's bridging function is also significant for social learning. Using silence to conceal differences can prevent strong sentiments that linger beneath the surface from arising, resulting in all relevant parties being included in collaborative problem solving. Clearly, resolving conflict through maintaining silence about competing realities and incompatibilities does not always result in desired outcomes. Leaving stones unturned considerably reduces the complexity of events. Relational tensions are kept out of the spotlight, but are not resolved. Deep-rooted animosities may suddenly be reignited and hard-won steps undertaken towards collective solutions undone.

Pearce and Littlejohn (2000) finally point out that communication is used for gaining control over others, for example when it is used for insulting, denigrating or repressing the opposition. One can achieve a similar result through silence, as when a powerful party does not recognize the existence of other's (Gendron, 2011). One can think here of groups that deny other parties legitimacy by erasing their contribution to the conversation or discussion. Silencing can also proceed very subtly when it relies on verbal devaluing. Gill (2009) explains how tongue-tying people neuters their resistance and ensures that their critique has minimal impact on work. An example of this is when superiors do not acknowledge complaints about workload and leave people the choice to accept it or 'get out of the kitchen, if they can't take the heat'. It goes without saying that silencing the voice of others signifies the ultimate failure to connect people and develop the productive relationships required for social learning. When people or entire groups are silenced, learning from each other becomes impossible, and confrontation, power play, and resistance between parties gets the upper hand. Bruneau (2009) describes silencing is a '"double-edged sword" that leads to grudges, stereotypes, interpersonal judgments, zoning laws, prejudices' and is eventually 'reciprocated with a blade that cuts in both directions interactively' (p. 884).

In sum, silence plays an important role in establishing relationships needed for social learning: it can preserve group boundaries and anchor identity, but also make communication with outsiders problematic; can help to seek out differences as well erect 'silent' boundaries; creates harmonious co-existence between diverse parties but simultaneously causes tensions to linger beneath the surface; and be utterly destructive to relations when used to control people. Which functions of silence are highlighted depends on the context and situation. To repeat a point made earlier, establishing social relationships that are productive to social learning means looking for the right balance between silence and speech.

Silence with regards to the process of social learning

So far it is argued that silence influences the commitment of parties to engage in joint problem solving, and defines the social relationships that are at its basis. As mentioned previously, the process also needs to be adapted in such a way that it

suits social learning. In terms of the process, silence needs to be accommodated in several ways (Gendron, 2011). The first way concerns ensuring the right actors participate in the learning process. Communication is usually seen as a key aspect for encouraging participation, clarifying what the project is about. Communication, however, can also discourage participation. De Bruijn et al. (2010) explain that formulating preconditions beforehand can give parties the impression that the process leaves insufficient room for their own interests to be served: 'The process becomes oppressive—parties experience it like a funnel trap: in the end there is only one possible direction for the process, and there is no way back' (p. 91). A degree of silence may be needed to ensure that voices that would otherwise not be present are also included. The inherent ambiguity in silence can be used by parties to leave the process open and give room to multiple parties to commit themselves to the process (Krieger, 2010). Hence, silence creates constructive ambiguity (Eisenberg, 2006) promoting unified diversity that allows for multiple interpretations to exist alongside each other around the same message. Nevertheless, when this ambiguity is maintained for too long, silence may result in a loss of focus, and parties may lose the goals of the project out of sight.

Another way in which silence is crucial for the process regards the alignment of relevant actors. Open and transparent communication is often seen as vital to alignment. By discussing progress with management or relevant stakeholders, parties inform others of what they are up to, engaging them with their projects and in the process becoming accountable (Wenger, 2000). Where communication creates openness and transparency, silence guarantees that the core values and interests of the parties involved in the process are preserved. Not informing stakeholders in the early stages of the process can help prevent accusations that are groundless, protecting actors from having to submit information that runs counter to their values and interests. This is especially relevant when the process is directed at social learning. Innovative projects often receive a wind of resistance; the constant pressure to keep all parties informed of progress would create a situation in which nobody would stick out their neck and commitment would be seriously jeopardized. Despite ensuring confidentiality and protecting members from outside criticism, silence may become dysfunctional when maintained for extended periods of time. Stakeholders may become suspicious when they feel they are not informed about progress, causing negative perception and ending in the loss of support for the process.

Silence is also significant with regard to the development and implementation of plans and strategies during the process. Obviously communication between parties is needed for organization and coordination, but too much talk can be detrimental as it distracts from the task at hand. Under the burden of constant interaction, many people will complain about the meetings they have to attend and it becomes difficult to carry out work with concentration and dedication. Especially when ideas that have not yet crystallized, creativity and experimentation is often reduced. Accommodating silence in the process can gives parties a chance to think outside of the box, and further develop new and innovative ideas. For example, to write an academic text is often essential to shut out noise and create a 'silent' place for contemplation. Creating room for silence in the process can thus give parties "creative time" to experiment with developing new ideas, exploring and generating options and develop alternatives and innovative solutions (Bok 1989; Krieger, 2001). Silence also give the process a sense of unpredictability and surprise heightening the value of what is being developed or designed. A final text handed over for a first reading is likely to attract more excitement than a version that has already been scrutinized by the reader several times. Bok (1989) has put it as follows: 'a peace initiative may be foiled if prematurely suspected; a symphony, a scientific experiment, or an invitation falters if exposed too soon' (p. 23). However, silence becomes dysfunctional when the process overemphasizes disengagement and separation, people quickly lose touch with each other and start working on their own. Inspiration and creativity make place for automation and routine. Novel ideas are less likely to emerge, and people start to reinvent the wheel.

This section has illustrated that silence plays a crucial part in terms of the process of social learning, giving parties sufficient reason to participate, create a safe atmosphere, and experiment and work towards a better result, but when there is too much time between moments of verbal communication commitment to shared goals can be lost. As always the same rule applies here: social learning means looking for the right balance between silence and communication.

Conclusion

Collaboratively solving complex problems is a process of building dialogue, of ensuring that the right conversations are being held, of creating shared and meaningful narratives, of telling stories that can connect people. Obviously, the skill to communicate productively and openly exchanging ideas is critical to nearly all aspects of social learning. In chapter, I approached the issues from a different angle, showing that social learning rests on silence at least as much as it does on exchange and conversation. Silence is not the opposite of communication, it fulfils a powerful variety of functions within communicative interaction that can influence social learning processes both positively and negatively: silence can provide time for reflection and prevent the transmission of valuable information, bring parties closer together and draw them apart; create room for interaction but can also close-off the interactional process.

Finally, I want to stress that appreciation of silence, and its many meanings and functions in social interaction, is valuable in the context of current changes occurring within universities and schools, which asks of teachers and scientists to carry out their work in dynamic collaborative contexts. Better understanding of how silence and communication interact can help teachers and scientists who have to collaborate with a diverse range of stakeholders on a daily basis. Without consideration of what it means to stay silent, or interpret why other choose to do so, one cannot fully appreciate the complexity of the communication process in which one is involved. Krieger (2001) points out that people must strive to identify the possible meanings that silences can have in their interactions so that they can

determine what are the best ways to communicate messages and interpret those one receives. Disregarding these functions can often lead to unreflective discourse and misunderstanding (p. 236). Moreover, awareness of silence in social learning can assist scientists working within universities and teachers to communicate more productively among each other, and with relevant others in the external environments. Detecting when people are too talkative or too silent, when they do not speak out of respect or are deliberately withholding information or covering issues up, and if the right actors are present or absent at the right meetings tables, creates the possibility to seek the right balance between silence and communication in these interaction.

In determining how silence influences social learning, it is essential to recognize that the functions and meanings of silence always depend on the conversational context: silence can mean that parties are reflecting at one moment, but can signal power in other situations. Consequently, for productive communication with others it is imperative to develop sensitivity for these different meanings of silence, and ensure that people keep their ears attuned to its distinct sounds in social interaction. Enhancing the skill of listening would seem a good place to evoke this sensitivity (Van Woerkum & Aarts, 2011). Listening is a crucial, but often neglected, component of conversational processes that can help people to reflect on problems, to learn to better recognize the habits of attention, and grasp how group members communicate with each other (Scharmer, 2001). Carefully listening to what others have to say can also help create more awareness for what is said beneath the words, to better grasp of the true meaning of the ongoing conversation. As Coulthard (2010) writes: 'one element of truly listening is to hear silence and to recognize that it is not silent at all' (p. 23).

05

SILENCE IN INTERCULTURAL COLLABORATION: A SINO–DUTCH RESEARCH CENTRE

ABSTRACT

China is widely recognized as a significant scientific partner for Western universities. Given that many Western universities are now operating in the Chinese context, this study investigates the everyday conversations in which international partnerships are collaboratively developed and implemented. In particular, it draws attention to the interpretations of the meanings attached to silence in these conversations, and how these can have unintended consequences for how these joint partnerships are accomplished. The findings come from an ethnographic case study that investigated collaboration within the context of setting up a Sino–Dutch research centre between the Delft University of Technology (TU Delft) and South China University of Technology (SCUT) as experienced by Dutch researchers in their interaction with their Chinese partners. The findings reveal that the Dutch researchers attached meaning to what was not said by the Chinese, interpreting it as lack of communication, resulting in judgements, uncontested trusts, and distancing that negatively influenced the achievement of common goals. Finally, the relevance of the findings is discussed for those managing communication in international academic partnerships.

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Introduction

'In human intercourse the tragedy begins, not when there is misunderstanding about words, but when silence is not understood.'
– Henry David Thoreau

'Though talking face to face, their hearts are a thousand miles apart.'
– Chinese proverb

Over the last decade, China has become a global leader in science and technology (Klotzbücher, 2014; Resnik & Zeng, 2011). China's total R&D expenditure exceeds US$ 163 billion; this is an increase of 18% within one year. Between 1998 and 2012, the number of students that graduated also increased steeply, from 830,000 to 6.2 million. In 2020, this number is expected to reach 10.5 million, almost a third of the world's total students (Bound, Saunders, Wilsdon & Adams, 2013); and China has over 1,800 higher education institutions and universities (Fazackerley & Worthington, 2007).

China's heightened visibility on the academic stage is widely noticed. Many European and US universities recognize China as an important academic partner and are encouraging various kinds of institutional collaboration with the country (Ennew & Fujia, 2009; Klotzbücher, 2014). These institutional partnerships generally take the form of joint research projects, collaborative research networks, branch campuses, or other kinds of large-scale projects, often under socially

relevant themes such as healthcare, sustainable cities, and life sciences (Bruijn, Adriaans, Hooymans, Klasen & Morley, 2012). Such partnerships offer opportunities to generate new research funding (Bound et al., 2013), access research facilities, attract potential PhD candidates and students, and gain a better international competitive position. Eye-catching examples of far-reaching collaboration are the opening of the University of Nottingham Ningbo, China, and Xi'an Jiaotong Liverpool University (Ennew & Fujia, 2009).

In contrast to typical international scientific efforts such as those directed towards co-publication, in which individual researchers collaborate, partnerships between academic institutions have a more strategic character and a higher degree of complexity. They require improved coordination and support of research and administrative, legal and regulatory requirements (Bruijn et al., 2012; Ennew & Fujia, 2009) and give rise to complex interactions between multiple scientists with different institutional and disciplinary backgrounds embedded in different cultural contexts (Klotzbücher, 2014). Although collaborating with foreign scientists is productive and exciting, the lack of intercultural competence is mentioned as an important reason why international initiatives do not produce the desired results (Cummings & Kiesler, 2005). Those collaborating with Chinese institutions have expressed specific challenges and frustrations (Li-Hua, 2007). Zhu, McKenna and Sun (2007) mention that Chinese negotiation behaviour is often found to be difficult and unintelligible, Herbig and Martin (1998) note that the Chinese approach of slowly building consensus for projects is often experienced as 'maddening', and Chua (2012) writes that many Westerners have a hard time understanding the habit of building 'trust of the heart'. Despite previous literature suggesting that scholars should further examine specific communication obstacles in collaborating with the Chinese, we know very little about the mechanisms that shape the course of intercultural interaction.

In this paper, we suggest that exploring how the meaning of silence is constructed and interpreted during intercultural interaction creates relevant avenues for understanding why collaborations develop as they do. Studies that consider collaboration pay attention mainly to spoken conversation, to what is exchanged verbally (Panteli & Fineman, 2005). Intercultural conversations, however, do not consist only of what is being said. From this paper's perspective, silence is regarded as indispensable for gaining a better understanding about the course of intercultural conversations; by failing to acknowledge these silences within the

functioning of international collaboration, we overlook a significant aspect of what collaboration is about. Despite work on silence in organizations (Morrison & Milliken, 2000; Panteli & Fineman, 2005), where it is strongly associated with a deterioration in organizational performance, silence is rarely investigated in the context of complex research collaboration (Verouden, van der Sanden & Aarts, 2016). Hence, the present study explores the significances of silence in the context of international research collaboration between the Netherlands and China, concentrating on how silence is constructed and interpreted during interactions between individuals and groups of individual collaborators. The focus of this paper is on the meanings of silence, including the effect of these interpretations on the course of the collaboration. Two questions structure this analysis:

(1) What specific meanings do the Dutch partners in the collaboration attach to moments of silence in conversations with their Chinese colleagues?
(2) What is the effect of these interpretations on the course of the collaboration?

Deeper insight into these questions is urgently needed because of the current internationalizing academic context in which universities are increasingly seeking to build lasting overseas partnerships with emerging global academic powers like China.

This paper first reviews studies of intercultural silence, distinguishing between intra- and intercultural approaches. Second, we discuss the findings of an ethnographic case study of the building of a joint Sino–Dutch research centre as experienced by Dutch scientists in their interaction with their Chinese academic partners. In particular, we demonstrate how the Dutch scientists' interpretation of moments of silence during intercultural conversations shaped the development of collaborative partnerships in often unexpected ways. The final section discusses how the results of our study add to current research on international collaboration and provides practical suggestions for managing the interplay between silence and talk in international academic partnerships.

Conceptual overview: the significance of silence and culture

The starting point of this study is that silence is of vital significance in human communication. As many authors have argued, silence is not the absence of noise but part of communication, often as important as speech (Jaworski, 2005; Tannen, 1984). Communication scholars indicate that the meanings associated with silence are not universal in nature, but defined by the cultural context (Krieger, 2010; Sifianou, 1997). Basso (1970) wrote: 'For a stranger entering an alien society, a knowledge of when not to speak may be as basic to the production of culturally acceptable behaviour as a knowledge of what to say' (p. 214). Furthermore, silences are not only rooted in their context, but are also part of a complex set of interpretations and interactions embedded in specific social interactions. The complexity of silence, Nakane (2007) explains, is amplified when one is investigating its meaning in intercultural encounters; this requires researchers to consider how varying norms and assumptions related to silence are interpreted. Hence, in analysing silence in intercultural communication, we distinguish between two approaches – one that understands silence as a cultural phenomenon, as part of distinctive cultural patterns and orientations, versus one that sees silence as embedded in the interaction between different cultures. We first discuss the intracultural approach, basing our discussion on the work of scholars who have theorized cross-cultural differences (Hall, 1959; Hofstede, 1991). In the subsequent section of this overview, we discuss its significance beyond specific cultural variations, explaining how the meaning of silence is open to interpretation, and how this can lead to

judgements, stereotyping, and problems in intercultural communication (Basso, 1970; Nakane, 2007).

Intracultural silence

First of all, a number of studies discuss the cultural meaning of silence from the perspective of high-context and low-context communication cultures, explaining how messages and meanings are conveyed in either a clear and unambiguous or implicit and subtle manner. Hall (1959) gives the following definition:

> A high-context (HC) communication or message is one in which most of the information is either in the physical context or internalized in the person, while very little is in the coded, explicit, transmitted part of the message. A low-context (LC) communication is just the opposite; i.e., the mass of the information is vested in the explicit code (p. 36).

Because people from high-context communication cultures rely less on verbal codes than on information induced from context, silence is a valued means of communication. In high-context cultures, fewer words are used and messages are often conveyed through silence. Studies have demonstrated that, for instance, in Asian countries like China and Japan, silence is a valued and efficient form of communication, where it is used to convey various meanings such as virtue, truthfulness, and respect. Lebra (1987) reported how the Japanese value indirect, implicit, subtle, and even non-verbal communication, trusting the listener's ability to guess what the person is inferring. This contrasts with studies of low-context cultures, like those of Germany, the USA, and the Netherlands, in which people are less comfortable with silence and do not accept that thoughts are implicit and discreet; they instead value direct and goal-directed communication (Bennett, 1993; Bruneau & Ishii, 1988). Although high-context cultures may find direct and open communication awkward, we cannot assume that all high-context cultures rely on silence. For instance, strong norms of hospitality in Middle Eastern or Latin American high-context cultures may encourage open communication about excitement, affection, and emotions.

The use of silence may seem more a characteristic of face cultures than of all high-context cultures. Face cultures are a specific type of high-context culture, in which the individual's sense of self-worth and self-image derive extrinsically from social interactions (Aslani, Ramirez-Marin, Semnani-Azad, Brett & Tinsley, 2013). In face cultures, silence frequently fulfils a pragmatic function (Jaworski, 1989), where it is associated with the saving of face. Previous empirical studies reveal that face cultures typically avoid discussions that involve disagreement and negative emotions that could embarrass or hurt other people and harm group solidarity. A frequently cited face-saving strategy is the use of silence as politeness. Extending Brown and Levinson's politeness theory, Sifianou (1997) portrays silence as the ultimate act of politeness. She distinguishes between two types of politeness silence: positive politeness silence, which serves mutual interests and builds common ground between parties, and negative politeness silence, which is used to avoid imposition and safeguards personal territory, as when we stay silent to avoid requests, warnings, or advice.

Yum (1988) for instance discusses how the Japanese consider silence a very important communication, associated with politeness and accommodation of others' needs. In her study of international Chinese teaching assistants, Lemak (2012) also reports that, whereas the faculty expected open acknowledgment of doubt, lack of knowledge, and understanding, students 'followed the Chinese cultural and linguistic practice of avoiding to speak up in a way that might cause the professor to think negatively of their ability. The use of silence and avoidance in formal contacts in the classroom was a polite deference and concern for maintaining appropriate face for unequal status interactions' (p. 497).

Third, the distinction between individualistic and collectivist cultures is related to the use of silence. Societies with a face culture typically have stable hierarchical social structures whose norms are based on collective interdependency (Aslani et al., 2013); they value harmony and interdependence rather than individualistic, outcome-oriented behaviour. This distinction can be recognized in the context of networking behaviour. In the West, networking is generally associated with individualism and highlights the commitment to personal tasks and projects (Luo, 1997; Ai, 2006). The individual transaction is seen as the most important unit of exchange. In China, networking behaviour is governed by the concept of *guangxi* (Zhu et al., 2007), which is rooted in social and moral norms of Confucian philosophy and refers to the personal contacts or connections that define one's

position in the social network. Unlike Western forms of networking, *guangxi* relationships do not draw a hard line between business and personal relationships (Chua, 2012; Herbig & Martin, 1998).

Silence is identified as an important part of the *guangxi* relationship. Relationships are often governed by an unspoken and unwritten code of reciprocity. Luo (1997) explains that *guangxi* is intangible and 'established with overtones of unlimited exchange of favours and maintained in the long run by unspoken commitment to others in the web' (p. 45). Within this relational structure, less powerful members of society or institutions accept that power is unequally distributed and do not openly question this arrangement; they follow interaction rules such as speaking when one is permitted to speak. Hwang & Ang (2002) explain that this disposition towards hierarchy is linked to silence and shown in the strong Chinese norms regarding the temporal management of turn-taking in which the highest ranking person is allowed to speak first on behalf of the whole group, while the others remain silent. In this way, silence marks solidarity and hierarchical relationships between conversational partners, conveying information about people's positions in relationships, authority, and rank.

From this section we see that silence can have a variety of meanings in communication, depending on the specific cultural context (Nakane, 2007). The previous studies offer valuable insights, enabling us to understand silence through the lens of culture. However, when they are applied to dynamic, real-life situations, dichotomies between speaking and silence are often less clear. Hence, to understand the complexity of silence, intracultural studies of silence must be complemented with a perspective that takes into account its role in intercultural interaction. Nakane (2007) observes: 'what is important for analysis of intercultural communication is not finding cultural differences to explain the participant's behaviour but understanding in what context and in what way participants modify or assert their cultural norms, or accommodate to the other party's cultural norms' (p. 34). Hence, the next section discusses silence in intercultural interaction, showing how different usages of silence are interpreted differently and how this can lead to judgements, stereotypes, and distancing.

Intercultural silence

First of all, studies of silence in intercultural encounters have shown that differences in silence usage can be a great source of misinterpretation. Compared to verbal acts, the meaning of silence is much more open to interpretation (Poland & Pederson, 2006, p. 308). Jaworski (1993) notes that 'silence is a cool medium of communication. It requires a high degree of participation and great involvement of the audience. ... a listener has to invest more processing effort in maximizing the relevance of silence than of speech ... [silence] requires more filling in, background information, and/or involvement' (p. 160). When people are not sufficiently familiar with one another and their customs or language, they infer from interaction what the other means by silence. This point is illustrated by Fujio (2004), who observed that Japanese managers exhibited more tolerance for silence than their US colleagues, who misinterpreted the Japanese silence in interaction as uncomfortable and frustrating. This misinterpretation is also a common feature of professionals where the verbal is a dominant mode of expression. Krieger (2001) gives the example of this inability to comprehend silence in the lawyering practice; he shows how lawyers interpret the silent or near-silent response of their clients in counselling as signifying agreement, even though they are still tentative about the specific offer.

Furthermore, when silence is misinterpreted, this can make people negatively evaluate each other's conversational behaviour (Nakane, 2007; Spencer-Oatey & Xing, 2005; Tannen, 1984). Silence leads to all kinds of judgements about another's character, motives, and personality. For example, Wieland (1991) shows how French participants judged Americans to be tedious talkers uninterested in contributing to the conversation, whereas the American participants felt that they could not 'get a word in edgewise' and were offended that they were excluded from the conversation. Jenkins (2000) found that Chinese international teaching assistants kept silent as polite deference to maintain appropriate face in unequal status interactions with their American counterparts who correspondingly interpreted their silence as a 'lack of motivation, isolationism, and unwillingness to cooperate' (p. 497). Lemak (2012) illustrates how students' silences led to harsh character judgements, perceiving students as ungrateful and lacking respect and the desire for education. Students who used silence to be polite and considerate were rated as tedious conversation partners.

Negative judgements about silence can increase the distance between people. This happens when judgements about an individual's character or personality become the basis for comparisons between communicative styles of distinct communities (Nakane, 2007, p. 15). Those who use less talk think of the more talkative group as pushy, hypocritical, and untrustworthy (Tannen, 1984). Scollon and Wong-Scollon (1990) show how different expectations about how long someone should speak can be at the root of inter-ethnic conflict. Studying interactions between Native Americans and American English speakers, they revealed how differences with respect to silence led to negative stereotyping, in which English speakers viewed the reserved nature of Native Americans as uncooperative, and even stupid, whereas the Native Indians regarded English speakers as too talkative. Similarly, Tannen's (1984) study of American communication norms demonstrated that talkative New Yorkers perceived slower Californian speakers as 'withholding, uncooperative, and not forthcoming with conversational contributions' (p. 108), whereas the slow speakers perceived the faster speakers as dominating and pushy. In a broader sense, Nakane demonstrates how conceptions of cultures as 'talkative' or 'silent' are integrated in broader, historically grown stereotypical notions such as the 'Silent East' as opposed to the 'Eloquent West' (Nakane, 2007). Polar opposites are created between entire continents on the basis of the meanings given to each other's speaking and silence behaviour.

The major conclusion that can be drawn from these studies is that the different meanings associated with silence can lead to misunderstandings in communication, causing negative judgements, stereotyping, and distancing. Despite these valuable insights, empirical studies on the role of silence in intercultural settings are lacking (Jaworski, 2005). Nakane (2007) therefore notes the need for more comprehensive research into silence in intercultural encounters, especially in today's global settings where intercultural communication difficulties are likely to arise.

The next section operationalizes the previous conceptual considerations by examining silence within an international academic collaboration setting, in which two large universities of technology from the Netherlands and China sought to build a Sino-Dutch research centre. Our study concentrates on how the Dutch researchers involved in this effort perceived, identified, and interpreted moments of silence during intercultural interaction with their Chinese partners.

Research setting: developing a Sino-Dutch joint research centre

This paper uses the material from a case study of a cutting-edge bilateral Sino–Dutch joint research centre established by the Delft University of Technology (TU Delft) and the South China University of Technology (SCUT). The reason for establishing the centre and intensifying international relationship with China was to generate common knowledge on smart and sustainable urban systems and infrastructure development. China presently faces challenges of an unparalleled scale in this specific area. Cities are heavily polluted, burdened by gross economic and social inequality, stressed by planned and unplanned migration, and affected by political vicissitudes. The country has been investing heavily in smart and eco-cities (Bound et al., 2013), for example devoting roughly US$ 10 billion to restructuring, energy-saving, reducing greenhouse gas emissions, and environmental protection (Bruijn et al., 2012). Many of the country's problems cannot be solved independently but require new approaches and solutions that can generate interdisciplinary knowledge on smart and sustainable urban systems and infrastructure development.

The centre aims to be a platform where both parties can conduct various types of academic exchange, joint research studies, joint education programmes, and joint application for projects by integrating their academic and research resources to build complementary advantages that can solve many of these global problems. The centre is meant to be an operational entity that coordinates and implements the existing and future activities of international cooperation between the two universities. The centre is part of the international strategies of both universities

and signifies the desire to deepen the international collaboration between both countries. The initial activities to build the centre were funded by donations from the two universities, which invested €125,000 yearly for three years.

Because of its broad interdisciplinary and international scope, the joint research centre offered an interesting case wherein to examine the significance of silence in an urgent, everyday intercultural setting. Setting up the centre comprised conceptually challenging interdisciplinary work, which required extensive discussions between scientists from diverse scientific disciplines and domains such as infrastructure, transport, architecture, policy and management, and civil engineering. Second, the collaboration posed specific relational difficulties. In contrast to many academic collaborations with China, in which previously established and existing bottom-up contacts between individual researchers are extended (Bruijn et al., 2012), whereby the existence of sufficient trust between parties is guaranteed (Klotzbücher, 2014), this centre was completely new and brought together Dutch and Chinese scientists who were not yet acquainted. For many of the participating scientists, it was their first time working with Chinese academics; this meant that they could not draw on previous experiences to shape the collaboration. In addition to the unfamiliarity of the interactional parties, the parties did not have a previous history of working with people from their own university. The members from civil engineering were added to the Dutch project group at the last moment. Put differently, it was a chance collaboration to launch a promising research project. Moreover, despite the complex intercultural character of the initiative, there were no external cultural mediators like Sinologists to support talk between participants. The scientists themselves were responsible for the course of the conversations. Given the complex intercultural dimension of the collaboration, the case study analyses how the Dutch scientists experienced and interpreted what the Chinese did not talk about and what they themselves did not say, and the consequences this had for shaping the course of conversations and the development of relationships.

Methods and analysis

The role of silence in the collaboration process was studied through an ethnographic approach that explored in depth the conversations between participants, using a combination of field observations, casual conversations, and interviews (Moore, 2011). Observations were conducted at two three-day workshops in the Netherlands and China, providing first-hand data about the interactions of scientists and academics involved in developing and implementing the joint centre. The workshops were intended to deepen the research collaboration, involving a delegation of researchers from the participating schools of architecture, technology, policy and management, and civil engineering as well as supporting staff members from the international offices responsible for coordination, communication, and administrative issues. They were coordinated and supervised by a council of directors from both universities, who were the basis of the party and consisted of leading professors from the respective schools. The council was responsible for the organization and implementation of the centre and for decisions regarding research such as assessing submitted bids and proposals. The first researcher participated in both bilateral workshops, which consisted of plenary meetings and several smaller roundtable meetings, and examined naturally recurring talk between researchers about the incorporation and development of research, educational, and valorisation activities within the centre.

In addition to the observations of official workshop interaction, the researcher participated in informal meetings and beyond-work activities such as lunches, dinners, and group excursions to observe participants' formal and informal com-

munication behaviour. This was an important source of data because it gave us a chance to become acquainted with the participating scientists within the group and talk to many of them off-the-record. Casual conversations were held with a broad selection of informants during formal occasions such as workshops and meetings, but also during informal interactions like breaks, lunches, and dinners, and explored their experiences and recollections of discussions and conversations. Informants were constantly asked to reflect on Chinese communication behaviour, and to define how they perceived and interpreted this behaviour. It was not possible to tape-record these informal conversations because of the fleeting nature of these interactions, but the researcher registered information on the spot using note-taking methods (Emerson, Fretz & Shaw, 1995).

An additional 28 interviews were held with Dutch researchers who were well informed on the collaboration, such as the council of directors, members from the international office staff, and a selection of professors, senior scientists, and PhD students who participated in both workshops. In addition, we interviewed university policymakers and directors, asking them about the broader relevance of the bilateral centre for the university's internationalization strategy. Standardized open-ended interviews were used to structure the variation in the questions, exploring what people expected from conversations, how they experienced and understood the unfolding of conversations, and whether difficulties were discussed or not within inter- and intra-groups. The interviews usually lasted an hour, were tape-recorded, and transcribed verbatim.

Although we initially aimed to explore the perspective of both the Dutch and the Chinese actors involved in the collaboration, it appeared difficult to initiate conversations with the Chinese, who engaged in conversation with colleagues or attended to their regular academic work at the sparse free moments in between meetings. It also proved difficult to arrange interviews. In contrast to the interviews with the Dutch, interview appointments with the Chinese had to be formally arranged through the international office; this made it difficult because they had to give up their sparse time to take part in a research project. Even though we interviewed the directors and staff of the international office and talked with several Chinese centre professors and researchers off-record, we could not collect enough in-depth material to give a full account of the Chinese experiences. For that reason, we have chosen to use the material relating to the Dutch scientists in this study, demonstrating in detail how these silences were interpreted by the

Dutch, how this led to misinterpretation and attributions, and how this influenced the achievement of common collaborative goals.

The findings were analysed using ethnographic methods, paying special attention to the moments of silence in the qualitative data (Clarke, 2005). Observational reports and interview transcriptions were coded and categorized, using the topics selected in the preliminary research design. The analysis consisted of continually re-reading and triangulating data from different sources and material, searching for patterns, guided by the Dutch researchers' interpretation of silence. We focused our analysis on how they identified and attached meanings to the moments when the Chinese did not speak, how they explained and justified their interpretations, and whether they raised and clarified them during conversations. The data were intended to develop a deeper understanding of how the Dutch researchers experienced communication during the collaboration process, including many moments of silence, and to interpret these silence in various ways. The discussion of the findings is structured by looking at the interpretations of silence at three crucial junctures and how these shaped the course of the collaboration, the preliminary setting-up phase and two large matching events in the Netherlands and China.

Findings

Developing the centre: the preliminary phase

The idea for the centre was developed and advanced by a small 'China-minded' group of scientists from the Dutch university. Personal fascination with far-reaching technological developments in China was an important impetus for establishing contact, as one of the initiating professors explains in an interview:

> 'I have this enormous fascination with China. I do not find everything fantastic there. Of course, there are many bleak sides to development. However, if you are interested in new technologies, system concepts, and infrastructural governance models, China is an outrageous laboratory.'

The project gained momentum when representatives from SCUT indicated interest in the bilateral centre. Initially, the two China-minded professors travelled abroad looking for support for their vision of a bilateral centre with a known university, but only when negotiations with the designated university failed did SCUT emerge as a prospective partner. As one informant stated, 'the project was simply relocated, it was a coincidence.' Once Chinese interest was awakened, an actual plan was needed that could be variously interpreted to match the interests of both sides. One of the Dutch initiators explains:

> 'Together with a staff member from our international office, I quickly drafted a conceptual plan for the centre. The other Dutch parties immediately approved of the plan. When we put up the idea for consideration with the Chinese at the level of their international office and vice president, they agreed immediately and involved the deans of the different schools, who didn't seem to have a problem with it either. Nobody commented on our plan, although I expect that the identification with it was probably weaker on the Chinese side. We were rather flexible in defining the theme of green cities in order to make it broadly applicable.'

Once both parties expressed their commitment to develop the plan together, the professors from the Dutch policy faculty took the lead in giving concrete shape to the collaboration, involving representatives from the architecture and civil engineering faculties of their home university, and presenting a finalized plan to the Chinese. In this early stage, the Chinese thus had a relatively small part in developing the plan, as a Dutch supporting staff member recalled in an interview: 'We developed and discussed the plan on our side and threw it over the wall ... If I had to do it again, I would establish a lot more contact with the Chinese side.'

In this early phase, when the Dutch took the lead, everything was seen as particularly promising. However, when the process moved to the decision-making phase, communication was experienced as more tedious. The Dutch viewed the visit in terms of closing the deal, yet, when they arrived in China to discuss the specifics with multiple parties, the Chinese were described as less eager than in initial conversations. Several Dutch informants mentioned the silence surrounding the Chinese decision-making style at this stage, as a Netherlands-based Chinese postdoc researcher who joined the Dutch delegation to China to sign the contract reported:

> 'In China, we were introduced to most of the participating researchers for the first time. We did not yet know one another very well. At this time, it was also still unclear whether the centre would become a reality or not. Whereas the international office knew about the plans for the centre, most of the Chinese professors were being informed about it for the first time. Nobody had a clear view about what was going to happen. Starting the communication was left mainly to the Dutch; the Chinese didn't say much at this stage.'

The staff member from the Dutch international office put it as follows:

> 'The decision-making process was extremely vague … Perhaps it is the Chinese way, leaving the process open for a very long time and not informing you along the way. You could not make out whether they were keen or not. Then, on the last day, when all the dignitaries were present, they suddenly presented a proposal to invest seed money … Before that, the process just lingered on … It felt like a snowball rolling in all directions.'

A Dutch member of the policy board echoed this feeling of not being informed:

> 'At the very last moment, when we were already wandering around the campus for three days talking and discussing things internally, at the very last moment, we were finally told that they wanted to go through with it. Up until the very last moment you don't have any indication of certainty, they just do not tell you.'

From the analysis above, we see that the Chinese way of communicating decisions with regard to the course of the collaboration was seen by the Dutch as involving many silences, which they interpreted as avoidance and the purposeful withholding of information relevant to the project. Although the Dutch found this behaviour unfathomable, leaving them in a state of puzzlement, at this stage it did compromise the process. Despite initial difficulties in the early phase, parties went on to sign the formal agreement in the presence of high-ranking officials from both institutions. With the formal and the financial support of both institutions guaranteed, the collaboration moved into the next phase, in which extensive academic exchange between researchers from the different participating faculties took priority.

The workshop in the Netherlands

In this section, we look at the three-day matching event organized in Delft to introduce and acquaint researchers with one another, and to have them explore and develop joint research studies, joint training and education programmes,

and knowledge valorisation and dissemination (advice, consultancy, and applied in-company research projects). Before the start of the event, Dutch informants emphasized the importance of making the discussion on the scientific meaning of smart city more concrete and of developing joint research projects:

> 'As the research centre is quite new ... we need to think about how to continue. What kind of research, who and how they will get involved. We are trying to speed up ... hopefully the centre will become more concrete.'

This desire to speed up the process and build scientific capacity was reflected in the bottom-up design of the workshop, in which exploring the tangibility of scientific work and matching individual projects and researchers were the first priority. For this, the Dutch board members invited individual researchers from their groups to present their research, revealing how it related to the broader objective of the centre.

The actual workshop, however, deviated from what was expected, revealing a somewhat different picture. When the Chinese delegation arrived in Delft, it consisted merely of eight high-level representatives, among whom the vice president, deans, several influential professors, and staff from the international office. An international staff member explained, rather annoyed, that 'this was not communicated by the Chinese beforehand.' This unfortunate mismatch in the participants' status and seniority was reflected in the presentations given by both hosts and guests. Dutch presentations focused predominantly on highly specialized scientific areas of expertise, clarifying narrow research topics such as scientific progress in roof constructions and sustainable and durable concrete with PowerPoint slides, frequently without connecting its relevance to the centre's broader research profile. One of the architecture board members commented on how the scientists from his school had failed to align their presentations to the Chinese context and social issues:

> 'They immediately showed some incredibly complicated, technical diagram, with 20 concepts that nobody knows outside their very specialized fields ... surely they could have orientated it more to the idea that we're trying to build collaboration ... See, I'm really cross about this. I was cross with our own people. I haven't said very much about it.'

Whereas the Dutch presentations were devoted to discussing specific research areas, those of the Chinese stood out for their formality, mainly articulating their desire to create a firmer basis and cultivate relationships, including many polite words in their talks, continuously stressing that TU Delft enjoyed an excellent reputation in China. In their presentations, some of the Chinese were not very fluent in English, and, because there was no translator present, could hardly be understood. When someone from the predominantly Dutch audience asked a question or commented on the topic of their presentations, asking them to explicate how they thought that concrete, individual projects could be realized, the Chinese steered away with polite sentences, emphasizing the value of bilateral relationships and collaboration.

During smaller, more informal faculty-to-faculty meetings, the Chinese communication behaviour was perceived as including even more awkward silences. These specific meetings were organized very informally to encourage the exchange of ideas between researchers. The Dutch adopted a casual and talkative attitude, immediately going into their research in depth. One of the invited Dutch policy scientists spoke uninterruptedly for 35 minutes about the quantitative analysis of public policy, a highly specialized topic. The presenters were clearly expecting comments or replies on their work (one invited feedback at the end of his presentation with: 'You can now ask stupid questions'), but the Chinese barely said anything in return, merely smiling and nodding politely. The most senior Chinese commented that the scientific approaches were 'very interesting and relevant to the Chinese context'; this was followed by a prolonged period of silence. Clearly uncomfortable, the Dutch researchers responded by filling the silence, explaining additional facets of their research work. Moreover, when the Chinese were given the opportunity to say something, they had not prepared a presentation of their own, and this caused a commotion.

Although nobody openly complained (at the closing ceremony it was even emphasized 'how extremely interesting the sessions had been'), the Chinese conversational behaviour was the subject of informal discussion within the Dutch 'we-group'. During the lunch break after the opening ceremony, people were talking about the 'long and tedious opening presentations of the Chinese,' in which 'everything except scientific projects was discussed.' One of the architecture researchers told us that she did not understand why the Chinese only talked about the reputation of their university and were silent on the subject of prospective pro-

jects, stating that it 'felt like they were staging one big performance.' With regard to the smaller meetings, informants mentioned being surprised that the Chinese did not contribute more to the discussions and generally found the 'prolonged silences after presentations uncomfortable.'

In a broader sense, the perceived lack of communication was associated with Chinese intention and character. Dutch irritation was for instance aroused by the fact that the Chinese had not prepared presentations for the smaller session. A researcher criticized them, saying that 'they did not even have paper handy to write down comments or questions,' taking this as an instance of Chinese indolence. One of the scientists, who was invited to present her work at the smaller meeting, mentioned that she found the lack of response to her research offensive, that it 'signalled a lack of appreciation for her work.' Some people were also concerned that the perceived lack of input into conversations would affect the partnership undesirably:

> 'I am concerned about the lack of Chinese input. Conversations certainly have not been very productive; they tend to rely on the Dutch to do the talking. The scientific expertise of the Chinese also leaves much to be desired. One of their reputed professors did nothing other than babble into the microphone.'

Another informant told us that he had experienced the conversational style of the Chinese as indirect and found it difficult to determine what motivated their visit, speculating that a 'lack of commitment to the centre' was behind it. In a similar vein, several informants said that they were afraid that the Chinese scientists were using the centre to improve the prestige and reputation of their own university rather than to find a mutually acceptable solution to scientific problems: 'they are not really interested in discussing scientific issues and projects and want our university primarily for its good reputation.'

Summarizing, we can see that, to Dutch eyes, the Chinese conversational behaviour again consisted of many silences, which mainly took the form of not contributing to conversation in an open and goal-directed way as desired by the Dutch. The Dutch found this behaviour difficult to understand, negatively interpreting it as a *lack* of communication, invoking doubts about the motivation and intentions of the Chinese. Not everybody felt this way however; many people were

still optimistic, emphasizing that the Dutch workshop was an 'important learning experience' and that more 'progress would be made in China.' Overall, however, people expressed initial concerns about the collaboration, and enthusiasm began to wane. Distrust gradually evolved.

The return workshop in China

Nine months later, the Chinese committee organized a return workshop in China. In between these two large workshops, a number of initiatives were undertaken separately to strengthen and intensify relations between the sides. For example, staff mobility was actively encouraged, a guest professor was appointed to a temporary position in China, and several smaller faculty-bound exchanges and workshops were organized. The China workshop was seen as a crucial next step in the collaboration process, as it brought together an even greater number of Dutch and Chinese scientists who had been given small research grants to explore possibilities for connecting their individual research. As the workshop progressed, the Dutch perceived the Chinese communication style as including many silences, which they related to the selective provision of information, responsibility for conversations, and entitlements to speak.

Selectively informing

A first issue that was seen as interfering with open and productive exchanges concerned the way the Chinese provided information about the process. Overall, Dutch informants had a very positive view of Chinese hospitality, commenting that they felt that the arrangements for the visit were particularly well organized. They mentioned that the 'Chinese rolled out the red carpet' and went to great lengths to make their guests feel welcome; an appointed private chaperon picked the visitors up from the airport, and they were wined and dined with copious lunches and dinners. Despite feeling very welcome, several informants nevertheless complained that the Chinese did not inform them enough about the workshop proceedings. This had already started during email exchanges before the workshop, when several informants mentioned that they did not receive answers to their enquiries. During the workshop itself, informants reported that it was 'hard and time-consuming to obtain information about the workshops.' One informant

explained that there was no workshop programme or timetable available, and that locations for meetings were not communicated. Even though he had explicitly requested supplementary information several times, he had never received an answer. Others grumbled about how the Chinese asked them late in the evening to prepare presentations for the following day, not understanding why they had not 'communicated this request at a more suitable time.'

Whereas some saw this as a minor nuisance, others felt that it obstructed the workshop preparation. A Dutch PhD student mentioned that she was uncomfortable with not being informed, because she had been awake all night and had not prepared her presentation in the way she would have liked. In a broader sense, people complained that many things remained implicit ('I have no clue what to expect of the workshop') and the workshop was very 'vague' and at times felt like a 'roller-coaster'. In the eyes of another Dutch informant, the Chinese 'did not feel compelled to provide sufficient information,' and this was an 'indication of poor planning' and 'lack of responsibility for the process.'

Shifting responsibility for conversations

In the Dutch visitors' opinion, an additional factor that stood in the way of open and productive exchanges was the issue of who was responsible for conversations. Dutch informants frequently mentioned that they could not comprehend Chinese conversational behaviour during meetings, reporting the loud answering of cell phones during presentations, talking among themselves in their own language, or suddenly walking away in the middle of a conference or meeting. One aspect of Chinese conversational style that struck Westerners as especially incomprehensible was the shifting of responsibilities for hosting and chairing meetings. In the Netherlands, informants explained, the ultimate responsibility for the meeting falls to the host, whose job is to introduce and address speakers and structure the discussion. Despite such expectations, during the China workshop, the Dutch felt that the Chinese left the responsibility for conversations to them, expecting them to do all the talking and explaining.

For example, we observed this during the joint welcome meeting on the first day of the workshop. The Dutch were invited to the Chinese auditorium, where they were seated opposite their hosts in a very large and formal meeting hall. Name cards were provided that marked the hierarchical pecking order. When it was time to officially open the session and proceed with the individual presenta-

tions, the Chinese remained seated and did not say anything, anticipating that the Dutch would take the lead in hosting the session. The Dutch, clearly not expecting or prepared to chair the meeting, exchanged uncomfortable glances, and in a small group deliberated how to continue. One of the key professors was clearly annoyed, telling his Dutch colleagues that 'they were the guests and the Chinese should take responsibility.' With nobody sure about how to proceed, there was an uncomfortable silence, which was broken by one of the Dutch delegation leaders who felt that something should be said. He proceeded to address the audience, hosting the rest of day, as he would later tell us, 'against his will'.

Similar incidents were observed in smaller meetings, during the second day of the workshop. For example, a senior architecture professor, who was suddenly expected to host a meeting, described the situation in an interview as follows:

> 'The professor who had arranged the meeting simply disappeared. She was in the corridor somewhere, chatting to people. I said: 'Who's chairing the meeting?' she shrugged her shoulders. … People just sat there while the Dutch person stood behind the lector wondering what to do. … I appointed myself as chairman of this session, but I was a bit annoyed about that because it should have been hosted by the Chinese side. … We ended up just talking to ourselves.'

Although Dutch informants could not always comprehend why their Chinese colleagues did not take responsibility for the conversations, and felt that this obstructed open and productive exchanges, they nonetheless accepted and tolerated their partner's behaviour. No mention was made of this discontent during the meetings or other joint activities. When asked to comment, one Dutch informant mentioned that it was a question of responsibility: 'They said nothing; we simply took our responsibility to encourage and facilitate critical discussion.' The Dutch furthermore evaluated the silence of their partners negatively, explaining how they found it 'annoying' and 'impolite' and that it 'curtailed open and meaningful conversations between researchers within the centre.' This often resulted in character judgements, in which the Chinese behaviour was pictured as 'unprofessional', 'uncommitted', or 'unmotivated'.

Entitlements to speak

A final silence that evoked Dutch concerns was the issue of collective communication norms, in which the Chinese social hierarchy between faculties was seen as interfering with open and direct conversations about the interdisciplinary objective of the centre. Different informants mentioned that Chinese scientists acted in accordance with the relative position of their faculty within the university, obeying the expectations and wishes of those of higher rank, claiming that not everyone could freely join in the conversation.

First of all, it was reported that Chinese scientists are seldom willing to give an opinion before their higher status peers, or were expected to remain silent or speak only when asked. One informant mentioned that her talkative partner become strangely silent during meetings when a superior was present, failing to articulate the progress they had made ('she just did not say anything anymore during the meeting'). In a broader sense, it was reported that individual Chinese researchers were discouraged by their superiors from talking to the Dutch. To the surprise of the Dutch policy delegation, the entire business economics research group that had visited the Netherlands was absent during the second workshop, which meant that they had to find new partners and start from scratch.

A similar incident occurred when a key Dutch policy professor heard through the grapevine that an anticipated Chinese partner was no longer allowed to participate in the centre, despite the considerable time and energy they had previously invested in building this particular relationship. Annoyed with this development, he tried to contact his envisioned partner, but was told that backstage politics were involved in Chinese frontstage obedience and nothing could be done. Another major incident occurred at the closing dinner, when members from the Dutch policy school were told that the research groups would breakup and dine in adjoining rooms in the same building. One of the policy professors was baffled, declaring that internal quarrels impeded the achievement of common goals: 'having the final dinner apart from each other will accentuate disciplinary differences rather than mutual objectives as envisioned by the bilateral centre.'

In interviews, Dutch informants indicated that respect for social hierarchy obstructed open and constructive conversations about the development of the centre, frequently accentuating their own Dutch egalitarian values, emphasizing that, in the Dutch scientific context, researchers were not restricted in 'what they could say and to whom they could talk.' The Dutch participants were hesitant to

interfere with Chinese internal affairs. Annoyed at being excluded by their Chinese partners, two of the leading Dutch policy professors tried to smooth things over by spontaneously visiting the architecture group, proposing a toast to their Chinese colleagues from that faculty. Despite this attempt, they did not push this issue very hard and could not avoid having to enjoy the rest of the evening only in the company of their policy faculty colleagues.

Despite viewing this as obstructing open and honest discussion, the Dutch did not raise these issues with the Chinese. The professor whose partners were suddenly removed from the collaboration explained in an interview how he found Chinese domestic affairs one of the hardest topics to address:

> 'Things are only undiscussable when they are really awkward, for example when they try to confuse one another. They do not like to talk about those things. They know they really cannot do that, but in China it is simply the case that organizations consist of warring factions. Although they treat one another in a cordial way at first sight, you often know that they are handing out blows beneath the surface … Once, I tried to mediate, but that was a waste of time.'

Not broaching the subject, however, exacerbated tensions. For example, it resulted in negative attributions about inter-faculty relations within the joint centre and a loss of confidence in the reliability of some partners. Several informants stated informally that they were annoyed and frustrated that the exclusion and silencing of speakers from the conversation made the limits of interdisciplinarity awkwardly apparent, explaining how it negatively influenced the attainment of common goals as endorsed by the bilateral centre. This led to attributions about the intention of the Chinese, best captured by the following key policy informant's conclusion about the workshop: 'The Chinese architecture professors are using the centre to establish and promote collaboration with other scientists.'

In sum, then, Chinese conversational behaviour was seen by the Dutch as including silences that interfered with their desire for openness and exchange. The Dutch felt that they were deliberately not informed, that they were impolitely expected to host and keep the conversation going and encourage people to talk, and that open and direct communication was impeded. This had a major impact on the quality of conversations. Chinese communication behaviour was negatively

interpreted in Dutch circles, leading to judgements about the responsibility, earnestness, and commitment of the Chinese.

Although the joint centre was still in its development stage, a sense of disappointment dominated after the second workshop. People did not want to dampen motivation, but there was a shared realization of the immensity of the challenge confronting them. Some people talked about the need to demonstrate progress, to yield quick deliverables; others stressed the importance of generating funding or creating more face-to-face connections and building trust. Some people seemed to have lost interest altogether, turning their focus of attention to other potential partners. If one thing has become clear from this study, it is that an important factor that will determine how the centre will develop is whether people will be able to find constructive ways to talk about, and bridge, their differences.

Discussion: silence in intercultural research collaboration

This paper began with the question of the moments of silence that could be identified in the process of establishing an international academic partnership with China, exploring the different meanings that the Dutch associated with Chinese silence, and how the interpretation of these silences influenced the course of the process through which common goals were to be accomplished. To answer these questions, we used material from an ethnographic case study, investigating the development and implementation of an innovative Sino–Dutch joint research centre in the area of sustainable urban systems and infrastructure development that required collaboration between a great number of scientists from different disciplinary, academic, and national cultures.

First of all, our study revealed that the Dutch participants, at various junctures during the process, perceived their Chinese partners as using silences within their communication. From the Dutch point of view, Chinese decision making was not transparent and involved periods in which the Chinese did not say anything for a long time, not conveying in an open and straightforward manner their interest in the collaboration. The Dutch also found their efforts to discuss the tangibles of scientific projects with the Chinese often unreciprocated, experiencing their communication style as indirect and unresponsive, culminating in awkward silences during the workshop meetings. In addition, the Dutch found that they were selectively or not at all informed by the Chinese about the workshop specifics, and felt that responsibility for chairing meetings and encouraging people to participate actively in discussions was left completely in their hands. It was also pointed

out that not all Chinese scientists participating in the centre were given an equal opportunity to talk freely within the context of the joint centre.

Even though silence can communicate many things, the Dutch frequently gave a negative interpretation to Chinese silences, as a lack of communication. The perceived Chinese behaviour of not speaking out clearly, failing to immediately provide feedback or reply to comments, not keeping people briefed, or silencing voices of subordinates, was not appreciated and portrayed as undesirable qualities of ongoing collaboration. Silence was seen, among other things, as needlessly delaying the process, impeding constructive discussions, and preventing centre researchers from talking freely and openly with one another. In other cases, silence was interpreted as the deliberate transgression of their desire for open and purposeful verbal exchanges (Tannen, 1984), for instance when speaking was considered the right of senior scientists and others spoke only when they were explicitly asked to share information. This confirms previous literature, in which silence is seen as 'something aversive or defective, and that it, somehow, indicated failure to communicate' (Lemak, 2012, p. 157). This negative interpretation must be seen against the norm of what is considered good and productive communication. The Dutch perceived Chinese conversational behaviour vis-à-vis their own assumption that collaboration requires open, informal, and goal-oriented communication. In this sense, their Dutch academic culture, and the specific norms and expectations about interdisciplinary conversation that it implied, had a powerful impact on how the communication behaviour of others was perceived and valued.

Although perceived silences were regarded as impeding a constructive evolution of the process, the Dutch did not discuss their partner's silences to find out what was really going on, for instance checking meaning, asking for clarification, or articulating discomfort or uneasiness. This suggests that sensitivities, assumptions, and evaluations are difficult to air during collaborative interaction. Several things may have compelled the Dutch to hold back opinions, sentiments, and personal interpretations, such as lack of time to respond immediately to others (Panteli & Fineman, 2005), not knowing how to make awkward differences discussible (Bennett, 1993), or a strong social pressure to adjust their behaviour and not to acknowledge the differences (Morrison & Milliken, 2000). Nevertheless, the result was that awkward silences were filled in, for example by further elaborating research during meetings or trying to entice the Chinese to say more than they did during group discussions. When the Chinese researchers did not respond imme-

diately, and their superiors did not encourage them to say something, the Dutch took over, hoping to elicit a response from the Chinese researchers. A spiral is recognized here through which values and norms about the meanings of silence and talk start to reinforce one another during interpersonal interaction. Those who do the talking start talking even more and more, whereas the others say less and less, leading to an amplification process in which opportunities to talk with, and understand, one another further decrease (Nakane, 2007).

Although our study clearly indicates that the Chinese communication behaviour was interpreted as silence, an important limitation is that we have not investigated the Chinese side in enough detail. Many of our observations seem to reflect the concepts found in the literature discussed previously, which mentions the relationship between silence and high-context communication, face, power distance, and group harmony (Chua, 2012; Herbig & Martin, 1998). Although the Chinese may have valued consideration more than involvement (Tannen, 1984, p. 107), using silence to build a good rapport, or instead found the Dutch way of talking pushy and boastful, expressing their dissatisfaction through refraining from talk, it is not possible to determine the precise meanings of Chinese communication behaviour from the current study. Future studies should therefore examine how Chinese scientists explain their own silence in collaborative situations as well as people's reactions to them; this will give a broader insight into their interpretations and therefore a fuller account of the dynamics of silence in intercultural communication.

Despite these limitations, our study clearly demonstrates that, if meanings of silence are not explained, this can lead to evaluations or judgements about character or intentions, putting distance between collaborating parties. Although reserve was demonstrated in public, Dutch participants talked about these occurrences within their own group, often seeing them as evidence that their partners were not involved, unmotivated, and impolite. The Dutch, for example, evaluated the Chinese disinclination to host meetings as impolite, or questioned the commitment and earnestness of some of their partners when they did not respond in expected ways. In particular, when the pressure to deliver results increased, this led to harsher judgements about the Chinese intentions with regard to the collaboration more generally, for example portraying them as calculating, ignorant, untrustworthy, and uncooperative partners. Consistent with the literature on the subject (Lemak, 2012; Nakane, 2007), silence provided a basis for unfavoura-

ble judgements in ongoing interaction. Such negative judgements may become shared understandings that are largely unchallenged. People start to legitimize one another's views in a we-group, repeating, strengthening, and adding to one another's claims and arguments, with the result that understandings become uncontested truths and are put forward in a no-matter-what context (Aarts, van Lieshout & van Woerkum, 2011). This affects the course of collaboration. In our study, initial excitement and fascination transformed into shared feelings of unease, annoyance, and irritation. Although the centre was still in its beginning stage, shared interpretations of silence caused defensiveness and profound feelings of distrust, increasing rather than bridging the distance between collaborators.

Conclusion and implications

This paper raises important issues for research on international academic collaboration, showing that interpretations of silence, unintentionally, shape the unfolding nature of intercultural interactions, creating distance between parties that are seeking to accomplish common goals. The discussion demonstrates that silence is part of intercultural communication that makes international research collaboration difficult to accomplish, and that it is deemed essential to our understanding of these collaboration processes. Of course, we do not suggest that our research is representative of all collaborations with Chinese universities. In this particular research, this problem of silence was exacerbated by the specific institutionally driven character of the partnership and by the fact that the two sides did not have a previous history of working together. Many successful international collaborations build on previously established relationships between scientists, formalizing these relationships when there is sufficient support and trust. However, if researchers collaborate mainly to accomplish university policy on internationalization, this can mean that they must work with people whom they do not know, creating a strong likelihood that familiarity with each other's ways of communicating, and trust to clarify unclear behaviours, are lacking. This leaves room for unexplained silences to enter and shape the process. As Jaworski (1993) notes: 'The more different another person appears to be from one's self, the more profound will be the silence of puzzlement, embarrassment, or anticipation of

disambiguation of the situation' (p. 135). The silence of misinterpretation is thus bred by unfamiliarity (Poland & Pederson, 2006, p. 298).

This suggests some practical recommendations. China is a growing scientific power and arguably one of the most important international academic partners for the future. Although there are many benefits from collaborating with China, scientists are often only poorly prepared to deal with cultural differences. Common membership of the scientific community is often seen as overriding national cultural identifications (Traweek, 1992). A major pitfall is that researchers may not see their problems as resulting from differences in intercultural communication. In addition to the long-recognized fact that increased intercultural competence can benefit collaboration (Bennett, 1993), we want to add that awareness of the varying shades of silence is particularly significant here and can improve how complex problems and differences are navigated in these project. Silences are often taken for granted and easily overlooked. In today's intercultural academic work, understanding how the interpretation of the varying meanings associated with silence shapes the course of collaboration is necessary for deciphering the situation and reducing possibilities for misunderstanding and negative attributions (Lemak, 2012). In particular, checking unexplained silences can help prevent uncontested realities being confirmed and reproduced in interactions (Ford, 1999; Aarts et al. 2011). In our own research, this could have stimulated the Dutch centre researchers to address sensitivities, assumptions, and evaluations openly and check for clarity and understanding, helping them to understand what their partners actually meant and adjust their communication accordingly.

In our own research, we also struggled with Chinese silences. During interviews, getting informants to talk about certain topics proved difficult; they often answered our questions very briefly. This contrasts with informants from the Dutch university, who often elaborated extensively on our questions. Our natural reaction was to repeat the question and push for answers. With regard to the role of silence in interviewing techniques, Poland and Pederson (2006, p. 300) explain that intercultural sensitivity often results in forcing participants out of silence into speech. With this emphasis on collecting verbal statements, we may have missed important cues about silence. The study itself, however, made us gradually aware that, when one perceives silence, this does not inevitably mean that there is no communication. This awareness is part of taking responsibility for the conversations that we construct with others. Sensitivity to differences in silence usage

makes us see that silence is always a co-construction, and that, by not checking or clarifying unexplained instances of silences during interaction, we may contribute to producing and keeping in place specific kinds of reality (Ford, 1999).

Despite the relevance of checking and clarifying unexplained silences, this is not always conceivable for scientists immersed in highly pressurized processes. Hence, international collaboration would benefit from skilful intercultural communication mediators. International academic projects often rely on the knowledge of foreign scientists participating in a collaborative process. In this particular study, Chinese professors and PhD candidates working in the Netherlands interceded between parties, for instance translating and giving cultural advice during interaction. Despite their valuable knowledge of both cultural worlds, volunteers are often poor liaisons because they have adopted the values of, and identify with, the host culture and may want to correct some of its key values. They tend to interpret rather than translate what is being said or not (Herbig & Martin, 1998). They may also be looked upon with suspicion in their own culture. Hence, independent and skilful intercultural communicators should be included in the collaboration process. In our research, such a person could have helped the centre researchers to educe the meanings of silence in meetings, making them hear clearly the meanings of what was not being said and working towards more constructive conversations about difference.

06

CONCLUSION

Verouden, N. W., & Sanden, MCA van der. (2016). Is Silence Golden? Silence in Interdisciplinary Collaboration between Scientists. *Journal of Science Communication, 15(05)*, 1-4

Introduction

In this thesis, I have presented an analysis and discussion of the meaning of silence in interdisciplinary collaboration concerned with positioning universities in relation to today's social problems – the public good. Effectively connecting universities to unprecedented societal challenges requires interdisciplinary collaboration between heterogeneous participants with diverse interpretations of the situation and divergent agendas in numerous settings and networks (Leeuwis & Aarts, 2011). Usually, this is considered to require open and transparent communication, in which people clarify and share their ideas and approaches to enable the effective sharing of data, results, methods, ideas, techniques, and tools (Bok, 1989; Resnik, 2006). Although this is widely agreed – among both scientists studying collaboration and policymakers – the ethnographic cases undertaken at the Delft University of Technology confront us with a different picture: when people participate in complex interdisciplinary collaborations, silence may be valued in addition to talking about salient issues and problems.

After the introduction, Chapter 2 discussed the role of silence in an inter-university context, focusing on the collaboration between engineers, spatial planners, and social scientists to reframe the university's traditional area of expertise in the field of water management in accordance with current societal changes. The chapter showed that, although silence serves various interactional functions such as securing group performance, keeping disagreements from surfacing, and managing conflicts of interest in the negotiation process, it shaped the course of interaction in ways that were not intended, resulting in a latent conflict between

parties. Chapter 3 concentrated on inter-university collaboration, revealing the importance of silence in the process-based introduction of an interdisciplinary educational course at the interface of health and technology. The chapter revealed that silences are actively used by interacting actors in their conversations with others to realize a productive and efficient work process across three universities, for example deflecting attention from difficult issues or leaving room for alternative ideas to surface. These silences may also become part of wider conversations, leading to uncertainty, problems with operational concretization, and a decline in motivation and commitment within the broader network. Chapter 4 offered theoretical insights into the connection between silence and social learning, describing how silence enables and constrains collaborative learning processes in groups, teams, or networks. Understanding silence in relation to the content, relationships, and process-related dimensions of ongoing interaction, it was shown, provides a firm basis for developing learning approaches that enable successful implementation of interdisciplinary projects and efforts. In Chapter 5, silence was scrutinized in the context of an international collaboration between universities, examining the intercultural interactions between Dutch and Chinese scientists in their efforts to develop and implement a joint Sino-Dutch research centre in the area of sustainable and green cities. The chapter made clear that all kinds of meanings are subtlety conveyed through silences during ongoing interaction, and that this can lead to misinterpretation, negative judgements, and stereotyping when the meanings of silences are not adequately understood and scrutinized, increasing rather than bridging differences.

The empirical chapters together demonstrate that, in the middle of interaction, it is not always possible to discuss issues and problems openly, and sometimes not even desirable. In extremely difficult interaction situations, in which different perspectives, values, and interests are represented, silence can be an effective way to tackle some of the tensions that arise during interactions whose objective is to arrive at common goals. Without silence, people would unnecessarily put their own credibility or that of others at risk, jeopardize the very relationships on which they depend for their academic work, or unnecessarily complicate or slow down work processes. From a communication perspective, then, silence is acceptable, even necessary, when people are interacting with others in complex ways around common goals. Silence must, therefore, be considered as part of interdisciplinary collaboration.

A main finding of this thesis is that silence can have various meanings and serve all kinds of interactional functions, but its use during ongoing interaction does not always benefit the accomplishment of shared goals. Everyday silences shape the course of the conversations that participants are having with one another in often unintended ways, leading to unspoken judgements, the exclusion of relevant others from discussions, the removal a critical opinions and perspectives, and the maintenance of vested interests. When looked at from the perspective of developing well-informed interdisciplinary collaborative initiatives, silence thus comes at a price: it constrains meaningful interdisciplinary interaction, adding to the creation and reproduction of problems and conflicts that undermine the common interests of the collaborating group or network.

In the rest of this concluding chapter, to provide an integrated answer to my research questions, I want to revisit some of the moments of silence identified in the empirical chapters. I first consider the main functions of silence and related consequences that can be identified in the context of interdisciplinary collaboration. Thereafter, I consider the significance of my work for optimizing future interdisciplinary collaborations, describing its relevance and offering some suggestion for academics, communication professionals, and university administrators that develop interdisciplinary policy. I end with some reflections on possible avenues for further research on the topic of silence. However, first I want to reflect briefly on the journey that brought me to see the significance of silence as a research topic in the first place.

From studying talk to hearing silence

Although my ethnographic explorations have now convinced me that silence is an important dimension of interdisciplinary conversations, I did not immediately notice its significance. It is so easy to get bogged down in verbal aspects of conversation – on what is being discussed between participants – that one barely notices the importance of what is not being said. As Mazzei (2004) writes: 'Our initial obsession with the spoken word renders us deaf to silent speech, left insensible to the voices and meanings inhabiting the intentional and unintentional silences' (p. 31). In developing my research proposal, I was mainly interested in naturally recurring talk about how to pursue and accomplish common goals, paying close attention to the contexts in which this talk proceeded. It was only during the course of research that I was confronted with the observation that many things were, intentionally or not, left off the table. Through my ethnographic study, I was able to capture the contrasts between what people did and did not mention in public. By observing numerous meetings, semi-private and private conversations, and email exchanges, interviewing and talking with informants privately, and systematically analysing the collected material for recurring inconsistencies and incompatibilities, I came to recognize that issues and problems were not reported or discussed, or were conveyed in indirect and oblique ways, at moments when open discussion would normally be expected.

Even if the unexpected findings make a great deal of sense with the advantage of hindsight, I found this observation striking at the time because its implications countered a great deal of the current research on interdisciplinary collaboration,

which foregrounds the discursive side of these processes. Besides studies on collaboration, only a few studies mention the role of silence in scientific practice, and mainly stress its role in commercial and competitive types of scientific research (Vermeir & Margócsy, 2012), often focusing on silence in relation to such things as raising doubt, censoring and distorting the 'facts', or outplaying competitors (Oreskes & Conway, 2010). Despite the valuable insights offered by these works, scholars have not paid attention to the silences used in the process of achieving common and interdependent goals through collaboration. This lacuna drove me to adjust the focus of my study to the significance of silence in conversations between multiple stakeholders.

In my field, anthropology, such a halfway change of lanes is not uncommon: it is not the research plan that dominates, but rather the quest to notice things that are not so obvious and are not immediately recognized. Researchers keep their mind open to potentially interesting issues or topics, including when they do not match initial research questions. What I eventually came to recognize throughout my research is that silence is a complex, multifaceted, and constituting component of conversation for interdisciplinary collaboration, in which it fulfils a range of explicit and subtler functions. In the words of Foucault, I learned that: 'There is not one but many silences, and they are an integral part of the strategies that underlie and permeate discourses' (Foucault, 1978, p. 27).

Four function and effects of silence in interdisciplinary collaboration

The main aim of this thesis has been to untangle some of the different functions and effects of silence in interdisciplinary collaboration undertaken in the context of the increased pressure on universities to connect their research and education around relevant societal problems. At this point, I want to answer the first two research questions: what main functions and effects of silence can be identified, and what are their effects? When the results of the different cases are integrated, four main functions can be distinguished, to which I refer as epistemic silence, relational silence, tactical silence, and interpretive silence. These types are of course extremes. In practice, people, depending on the interaction context, use mixed forms of these extremes. Collaborative efforts may include two or more types at once. The presented silence inventory is therefore best seen as a heuristic tool intended to nourish the debate about interdisciplinary collaboration, laying out some avenues for further research and practical interventions. In the next sections, I describe these four main functions and effects, discussing first the functions and how they relate to specific collaborative challenges, followed by their effects (see fig. 1).

Epistemic silence

The first variant of silence is associated with the challenge of integrating and sharing knowledge across disciplinary, faculty, and professional boundaries. Inter-

disciplinary collaboration is based on epistemic dependence between individual experts with different fields of expertise (Hardwig, 1986; Turner, Benessaiah, Warren & Iwaniec, 2015). Epistemic dependence implies that parties are dependent on one another's knowledge and expertise, and that they must share and integrate this knowledge to tackle complicated interdisciplinary problems. Despite the fact that participants must be able to relate their particular disciplinary knowledge to that of others, people may be confronted with varying expectations that require the safeguarding of disciplinary areas of knowledge and the maintenance of professional autonomy. Interdisciplinary projects always presuppose a trade-off between depth and breadth (Turner, et al., 2015). The cases indicate that silence, in addition to talk, is a common way to meet this challenge, where experts use it to retain a respectful distance towards one another in interaction when the boundaries of expertise are not clear. The role of silence in managing the dilemma between depth and breadth in projects has two aspects.

Safeguarding expert positions

First of all, silence is used to safeguard expert positions in interaction. Whereas many studies have shown how scientists rhetorically establish their competence and credibility in debate (Bijker, Bal & Hendriks, 2009; van Rijswoud, 2013), silence also plays an important role here. In disciplinary contexts, scientists may appear credible and command respect because of their proven track record. Working in new and unfamiliar interdisciplinary contexts, experts may lose the halo of expertise that they enjoy when interacting with colleagues or partners with whom they are familiar. As a result, they may want to give off a particular impression of themselves (Goffman, 1969), constructing themselves as credible and able partners.

Talking about difficult issues or problems outside the narrow confines of one's disciplinary field can pose a threat to the construction of credibility. Collaborative knowledge construction requires experts to open themselves up to difficult questions or contestations from others that they cannot easily answer or contest. Even though people may be interested in reimagining or enlarging the problem setting (Turner et al. 2015), when they feel their expertise is on the line this can make them reluctant to express new and original ideas and ponder the limits of their knowledge – to question the threshold. Not talking about the breadth of knowledge is a typical way of ensuring that identity is not contested in the cacophony of

expert voices. An example of this is given in the China case (chapter 5), where an interdisciplinary group of Dutch and Chinese scientists constantly brought their disciplinary specialty to bear in workshop presentations on the future of green cities. Even though the workshop was intended to explore boundary issues and expertise in the area of green cities, participants did not talk outside of their deep knowledge area, taking the side of least drama, not sticking their neck out, being cautious about what they presented. Silence demarcated the line of what could safely be talked about, setting the boundary of expertise, ensuring that participants presented themselves as credible partners.

Respecting expertise

Second, scientists need not only to maintain their own expertise, but also to ensure that their conversational partners' expertise is respected. Hence, when interacting with other experts, scientists may not only keep their own discussion within the confines of their fields, but also decide not to probe or question the work of others. This difficulty is compounded by the multifactorial relational nature of interdisciplinary work. Collaborating experts are often working with people with whom they have never worked before and may be unfamiliar with one another's work, fields, or scientific approaches. Even though projects require them to talk with one another about extremely complicated issues and problems, they may feel that they do not know enough about a specific field or discipline to make a constructive contribution. Engaging in exchanges about the knowledge of experts whom one does not know can feel like overstepping the mark. Collaborators may be careful not to misinterpret or compromise a colleague's work by missing the right nuance or complexity, as this can be perceived as a posing a threat to, or violating, the credibility of others. It is by their silence that they show respect for the boundaries of others, ensuring that credible identities can be presented and maintained in interaction.

In summary, then, epistemic silence is closely connected to identity-related activities that people perform, ensuring that the credibility of conversational partners is maintained in interaction.

Unintended consequences of epistemic silence

Despite the role of silence in shaping credibility in knowledge exchanges between experts, epistemic silence has consequences for the integration of knowledge dur-

ing the course of interaction. Although it is necessary to ensure a respectful distance towards one another during interaction, for new and innovative approaches to emerge, collaborators must find ways to challenge one another's fundamental assumptions (Turner et al. 2015), asking penetrating questions about one another's work, and putting one another's ideas to the test. When people maintain a silence to preserve distinct identities as disciplinary experts, this keeps them from talking about and knowing one another's work and helping one another forward. Undecided issues, uncertainties, and unanswered question do not enter into the conversation. Parties merely come to the table to inform one another. Intellectual contributions are strictly focused on what is already known within the involved disciplines, leading to the reproduction of existing opinions, ideas, and perspectives.

Moreover, the constant reproduction of disciplinary opinions, ideas, and perspectives in interaction causes the distance between different kinds of expertise to become larger instead of smaller. To return to the China case (chapter 5), Chinese and Dutch scientists were too preoccupied with carving out and managing specific identities as disciplinary *experts*, transferring to others the specifics of their expertise in a particular field, as a result of which they never went beyond an explanatory style of talk. Exchanges intended to delineate unknown areas of knowledge and explore potential knowledge gaps were limited to in-depth discussions of their own accepted and established areas of expertise, to which people outside of these fields often could not relate. This is an example of how, despite integration being sought, alternative knowledge paths that could potentially lead to the formulation and development of new ideas and perspectives are closed off. Discrete intellectual perspectives are maintained instead of blending multiple approaches into one unified intellectual perspective (Turner et al. 2015).

Relational silence

The first variant of silence is associated with the challenge of talking across epistemic boundaries, coupled with the need for respect and maintaining expertise. In addition to this epistemological dimension, silence is tied to the social and relational nature of organizational work (Morrison & Milliken, 2000). The building of mutual interdependencies between a variety of actors is a key factor of interdis-

ciplinary collaboration (Farrell, 2001; Shrum et al. 2007; Stokols et al., 2008), but scientists must also safeguard dependencies on which they rely for disciplinary work and careers. Silence plays a vital role in mitigating this relational challenge, ensuring that friendly and smooth interaction is achieved and sustained with a variety of different actors with the network. Relational silence therefore refers to the silences used to interactively protect and construct relationships in collaborative interactions. From across the cases, three aspects were identified as important here: withholding, avoidance, and accommodation.

Protecting relations

First, silence is associated with the withholding of opinions or concerns to protect one's own position within relational networks. Although university imperatives bind scientists together around common goals, scientists may not see it as their core task and they are not too keen on getting themselves into trouble by going to the bottom of issues and arguing with colleagues in specific departmental and hierarchical relationships. Even though scientists benefit from building new alliances (they can gain prestige, reputation, and status), they are also involved in more or less enduring relationships on which they rely for social capital and career advancement (Morrison and Milliken, 2000). When parties with their own strong agenda must represent the agenda of their close colleagues, this puts them in a position in which they have to reach consensus without damaging the position of their own group or department and relations with other departments and their professors. This creates a situation full of tensions, in which the participants need to manoeuver with a lot of caution and care and may withhold critical opinions or perspectives from difficult conversations, tailoring their views to the pressure of the group.

Creating consensus

A corollary to the above dilemma is the challenge of safeguarding stable patterns of interdependencies on which the group or network depends. This sub-function of silence is more broadly motivated by the team or group's collaborative concerns. Because of the complex nature of interdisciplinary efforts, raising certain issues may be perceived as potentially compromising relationships on which the group or network depends, and sensitive topics may be kept out of conversations in order to ensure that a veneer of consensus is maintained (Goffman, 1969). As

a result, 'hot' topics may be avoided to secure consensus. The medical technology bachelor case (chapter 3) revealed how potential areas of disagreement were avoided by all parties to protect the interdependencies among engineers, medical scientists, and practitioners needed to implement the programme across three universities. During meetings, arguments and confrontations that could stir up unwanted discussions and derail the process were kept out of the discussion, establishing a consensus in complex multi-party situations where confrontation could have caused parties to back out of the process.

Conflict resolution

Finally, silence plays a role in conflict resolution. Even when the majority of participants avoid specific disagreements, it is not always possible to keep conflicts of interest out of the conversation. Inevitably, conflict will occur at some stage of the interaction (Shrum et al., 2007; Sonnenwald, 2007). As shown in the water management case (chapter 2), silence is a common response when actors endowed with power and authority put stakes on the table that threaten consensus building. Instead of debating and resolving issues, and thrashing out areas of disagreement, parties respected one another's stake in the game, accepting the prioritized issues and interests and accommodating them into the process in return for a conflict-free interaction process. Silence is set to work in the management of conflict, helping to conceal the tension-filled and conflict-ridden nature of collaboration, de-escalating interaction so that a balance of power is maintained.

Unintended consequences of relational silence

Despite the benefits of relational silence discussed above, silence can unintendedly effect how relationships develop during the course of interaction, curtailing the space for elaborate discussion and for expressing opposing or critical viewpoints. When disagreements are not acknowledged and expressed in the course of interaction, differences in opinion are not managed effectively (Morrison and Milliken, 2000). At the interactional level, this is revealed as having an indirect influence on people's thoughts and subsequent behaviour. When silence is used to protect relational positions, this prevents parties from understanding one another's feelings and deeper interests or motivations. As seen in the water management case (chapter 2), because people did not have the room to express their critical thoughts, they did not feel heard, and this affected their commitment.

This not only led to frustration with the way the interaction was developing, but also caused negative views to be expressed in other contexts and settings.

Perhaps the biggest issues with this is that it creates the illusion of friendly and smooth interaction, but drives differences and conflicts underground. This is most clearly seen in the way silence affects the character of negotiations. When parties resolve conflicts of interest through silence, this can easily lead to distributive negotiations. As the water management case demonstrated (chapter 2), in distributive negotiations actors attach themselves to existing visions and positions and a fair cutting of the cake. This is different from integrative negotiations, which are based on group formation, sharing perspectives, joint problem analysis, and identification of problems, and where joint and creative solutions are sought. Aarts and van Woerkum (2016) emphasize that such distributive compromises are not very stable, because the source of the conflict is not removed. When this happens, unspoken fault lines are created that can in time develop into latent conflicts that increase rather than decrease the distance between the parties. Although silence seemingly provides smooth interaction and consensus in the short term, it thus unexpectedly contributes to, and magnifies, relationship problems in the long term (Panteli & Fineman, 2007), leading to the perpetuation or even escalation of conflicts.

Tactical silence

As collaborating parties must also ensure a productive and efficient work process, which requires coordination of time and resources, shared planning and decision making are needed. The complicated and shared character of interdisciplinary efforts can entail what Cummings and Kiesler (2005) have called coordination costs; this means that the benefits of integration and collaboration are complicated by the presence of different approaches to work and coordination of activities. Typical coordination problems are mitigating the lack of a formal work structure, balancing time pressure with the labour-intensive character of projects, creating participation, and enhancing collective ownership across multiples sites and parties (Cummings & Kiesler, 2005; Finholt, 2003; Stokles et al., 2008). Managing these coordination challenges can lead to using silence in a tactical way. Tactical silences are different from strategic silences, which are usually associated

with blatant opportunism: to lie, to obscure, to influence, or to exercise power over others (Oreskes & Conway, 2010). From the cases, three sub-functions of this variant of silence can be identified: enhancing participation, allocating time, and creating room for manoeuver.

Enhancing participation

When projects require the participation of multiple parties, tactical silence can be a way of enhancing participation. For example, deliberately not naming or articulating certain aspects of plans can deliberately heighten ambiguity, allowing different interpretations and positions to co-exist. As the China case (chapter 5) shows, in order to engage a large team of architects, policy scientists, and engineers with very different takes on the theme of sustainable city, core concepts and notions were assumed rather than clearly spelled out. Precisely because plans were not tightly defined from the start, the intellectual boundaries of the project could be stretched to include many different stakeholders from the universities, who could connect their expertise and interests to the overall goal of the centre. Silence created room for manoeuver, allowing perspectives and objectives to co-exist.

Managing time pressure

Silence also ensures that the right topics are talked about at the right time. Under time pressure, it is crucial to ensure that the projects are heading in the right direction with minimal delay (Shrum et al., 2007). To maintain course, conversations must not drift away, for example because participants continue to discuss a particular topic endlessly. When this is the case, conversations may be more productive when certain issues or problems are not talked about. Silence can be used to postpone certain issues, temporarily 'parking' them until the time is ripe to address and resolve them.

Creating room for manoeuvre

Silence has also been shown to benefit the decisiveness needed to resolve tough issues and problems. In large-scale interdisciplinary efforts, planning consists of a series of decision sites that can never be fully inclusive of all the potential participating voices. Many people and parties have (or may want to have) a say on issues, making it impossible to guarantee win-win situations for all the actors included (Van Assche & Costaglioli, 2011). Sometimes it is easier to include only certain

voices in the conversation, but this means that others temporarily have to be excluded and silenced. This silencing of certain voices may benefit decisiveness, as demonstrated in the medical technology case (chapter 3), where open and shared decision making was at times sacrificed for more private, backstage meetings in which participants could talk freely about controversial issues to keep plans and priorities on track. This ensured that this very time-consuming and tedious process could at least be brought a small step further.

Unintended consequences of tactical silence

Tactical uses of silence benefit decisiveness, help keep options open, and create possibilities for talking freely about controversial issues. Despite all that however, they all too often have consequences that are unanticipated and unintended when looked at from a broader interactional perspective, leading to the neglect of interdependencies among work processes (Henriksen & Dayton, 2006). In planning and coordinating work processes, participants are highly reliant on one another for the successful development and implementation of work. The use of silence to enhance participation can for instance obstruct further development and concretization of plans at other junctures or stages of collaboration. In the China case (chapter 5), it meant that vague research goals were formulated, resulting in confusion and frustration in later stages when articulation could no longer be delayed. Participants may thus feel that it is better to just let things hang in the air, but unarticulated issues put perceived agreements and consensus under pressure down the track when people can no longer afford to keep silent.

When used to manage the workload of already busy people or drive decisions and roll out ideas, tactical silences can cause a narrowing of the focus to a limited range of simple and feasible talks or cause people to make decisions without considering all of the available alternatives (Janis, 1982). The medical technology case (chapter 3) shows how sidestepping difficult issues, for example by holding discussions behind closed doors, leads to poor work design. Excluding relevant actors from the ongoing discussion may have helped to move plans forward, but at the same time caused a disconnection between ultimately interdependent conversational contexts. The result of this was that excluded actors became less committed, causing collective ownership of the project to decline. In sum, then, tactical silences are used to tackle some of the difficult operational problems that people face when working independently on projects, but can also make these processes

considerably more burdensome, leading to ill-considered decision making and poorly designed and fragmented work processes (Henriksen & Dayton, 2006; Perlow & Repenning, 2009).

Interpretative silence

Another challenge crucial for interdisciplinary collaboration involves creating common understandings and shared meanings. Collaborators do not only create patterns of interaction; they also need to figure out what one another's contributions mean. Parties need to make sense of, and agree on, rules of exchange, even while disagreeing on the meaning of the exchange process itself. Many studies of collaboration demonstrate that creating such interactional alignments occurs through framing (Dewulf, Gray, Putnam, Lewicki, Aarts, Bouwen & Van Woerkum, 2009), in which people impart meanings to the ongoing interaction while co-constructing what they find important, but silence is used alongside speech to convey additional meaning about the interaction. In its interpretative function, silence serves as an "expressive activity" used to convey communicative content (Panteli & Fineman, 2007, p. 348). An interpretative silence occurs when things are being said by not saying them (Tannen, 1984).

Communicating personal information

One way in which interpretative silence is used is to communicate personal information (intentions, agreement, expectations) within conversational exchanges. When conversational partners have to determine and accept the purpose and direction of the exchange in which they are engaged, they rely on what Grice (1989) has called the cooperative principle: they make an effort to make their intentions as clear as possible, and try to find out exactly what the conversation is about. To comply with this, conversational partners must convey just the right amount of information, and above all must be clear about what they mean, avoiding ambiguities. However, on certain occasions, it may be valuable to implicate rather than state intentions explicitly. Especially where minimal mutual understanding exists between the parties (Janis, 1998), and parties do not yet know what to expect of one another, they will not find it easy state things in an explicit way, instead using silence to get across the message in a subtler and more indirect and unambiguous

way. As we saw in the China case (chapter 5), silence was used to indirectly express disapproval, patience, and interests, or to politely or tactfully turn down proposals in a way that meant that nobody was openly offended.

Communicating contextual information

In a broader sense, silence can convey meta-information about the interaction process itself during conversational exchanges. Interdisciplinary collaboration is often marked by unclear roles and responsibilities about who is to speak at what time. Hierarchical relationships between scientists are complex, and raising issues about power can be difficult. When scientists are watchful of the hierarchy, silence can fulfil a "procedural role in directing discourse", shaping what action should be taken by whom, for example activating or encouraging people to take the floor (Ephratt, 2008, p. 1920). As the China case (chapter 5) demonstrates, Chinese scientists used silence to acknowledge the entitlement and responsibilities of parties to speak or not. Through the use of silence in their turn-taking behaviour, they signalled to one another how the interaction hierarchy was to be interpreted: who was to speak in which specific order (Nakane, 2007).

Unintended consequences of interpretative silence

Despite silence being part of the process through which people frame interaction, the cases point to its unintended effects on the interpretation process. Silence can for instance be a way of shifting responsibility (Aarts & van Woerkum, 2002), ensuring that what is conveyed can easily be taken back: 'These are your words,' 'I did not mention that.' Additionally, silence can be a source of misunderstanding. Importantly, the notion of silence significantly differs from verbal modes of expression, in that it provides fewer behavioural cues than voice and therefore is much more ambiguous than voice (Dyne, Ang & Botero, 1999). Accordingly, the meanings of silence are very subtle and highly open to interpretation (Poland & Pederson, 1998, p. 308). Adequately interpreting silence requires a high degree of participation and great involvement by the participants, as Jaworski (1993) notes: "silence is a cool medium of communication… a listener has to invest more processing effort in maximizing the *relevance* of silence than of speech… [silence] requires more filling in, background information, and/or involvement" (, p. 140). However, in interdisciplinary projects, there may not be such regular interaction between parties. Face-to-face contact is often restricted, and this can make it

very difficult to discern the intentionality of silence during the sparse moments of interaction (Nakane, 2007). This can lead to what Poland and Pederson (1998) have called "encultured silence" – silence that refers "to the inability to hear or be heard because one's life expertise is sufficiently different that one does not know the customs and language of a particular world" (p. 298).

The cases give a number of illustrations of this. It was most evident in the China case (chapter 5), where silences led to serious misinterpretations in the confluence of international scientists around socially relevant issues and problems of green cities. Confronted with silences they could not immediately understand, Dutch scientists had trouble inferring the meaning of what was not being said by their Chinese counterparts, taking their silence as a lack or failure of communication instead of a meaningful expression. This ostensive lack of communication was inaccurately interpreted as a sign of passivity, lack of commitment, or even disrespect. The longer these interpreted silences remained unchecked during the course of interaction, the more negative people became about how the course of the interaction was developing, reaffirming their negative perceptions by drawing on overly simplified assumptions and stereotypes. Judgements are made not about how others speak but rather about their abilities, personalities, or competencies (Tannen, 1984). In brief, then, although silence can convey meanings in a subtle way, this subtleness can be the cause of misunderstanding between collaborating parties, shedding new light on the crucial issue of how misalignment in interdisciplinary collaboration occurs (Dewulf et al., 2009).

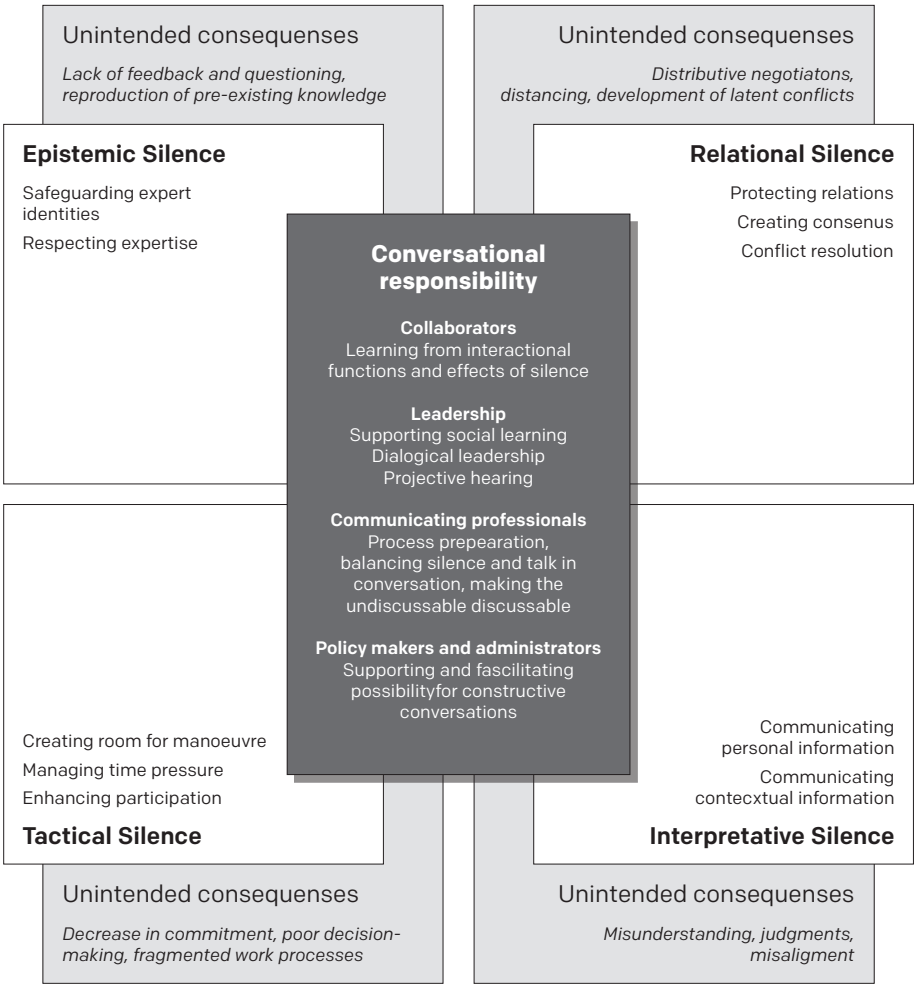

Fig. 1. Four functions and effects of silence and implications for practice

Practical considerations: conversational responsibility and interdisciplinary research collaboration

Now that I have distinguished the four main functions and effects of silence, I turn to my third research question, which concerns the practical recommendations that can be made on the basis of the results of this study to optimize future collaborations that seek to connect universities to today's social problems. My research findings suggest that the role of silence should not be neglected in situations involving communication in complex multi-stakeholder collaboration. Despite the potential value of silence for promoting more effective interdisciplinary interactions, giving prescriptions or suggestions on how to deal with silence is exceedingly difficult. A typical recommendation found in much work on organizational silence is the suggestion that encouraging voice and overcoming silence is the route to optimizing organizational performance (Morrison & Milliken, 2000).

My conclusions, however, suggest that this is a harsh oversimplification of the issue. To repeat a point made earlier, silence in itself is not a problem of rapport or eliciting voice (Poland and Pederson, 1998, p. 308). Silence must be considered as part of collaboration. Some things fester in silence, others wreak havoc if voiced (Argyris, Putnam & Smith, 2009). Another way to approach the issue is to follow Elias and consistently take dynamics and relative unpredictability as our starting point, making us better able to act consciously and respond to specific contexts more adequately (Elias, 1970). Such an approach acknowledges that we constantly need to be aware of, and reflect on, the meaning of silence within specific conversational moments and occasions, tracing how it effects the further unfolding of the conversation that these people are having with one another. Shifting attention

to silence does not mean conceiving conversations in a completely different way, but rather recognizing the relational dependency of talk and silence (Jaworski, 2003). Rappert (2016) writes: 'Within the unfolding, moment-to-moment interactions of conversations, the importance of silence and talk can be reliant on one another. The meaning of these both is shaped by situational expectations and they help constitute those interactions as particular kinds of situations (ordinary conversation, professional talk, office banter)' (p. 9). Encouraging ongoing reflection on the role of silence in interdisciplinary conversations can trigger learning processes that create more awareness of how common goals are constructed in conversations with others, providing fertile ground for developing more constructive ways of talking and listening that allow interdisciplinarity to emerge (Baker, Jensen & Kolb, 2002). One can think here of projective hearing (van Woerkum & Aarts, 2011), in which the skill of listening to silence coupled with reflective responding is an alternative to a strong delivery style and can motivate fellow collaborators to communicate more effectively. I will return to this point later.

The above also resonates with Ford's (1999) notion of 'conversational responsibility', which refers to the growing importance of people becoming aware of, and accepting, the consequences of our speaking and silence behaviour (p. 493, see also Aarts, 2015). Ford (1999) writes: 'Conversational responsibility makes it possible for us to own both our speaking and our silence as choices we make rather than attribute either to the persistence or absence of forces outside ourselves' (p. 493). Conversational responsibility is practiced when we realize that our conversations are never non-committal and language is accordingly used in a careful and responsible way (Aarts, 2015). In the specific context of this thesis, I take conversational responsibility to refer to fostering commitment to interdisciplinary conversations intended to achieve common and interdependent goals, the common good. In the following sections, I reflect on what all of this means for collaborators themselves, for communication professionals that support these processes, and for university administrators trying to create a climate conducive to interdisciplinarity where actors become more responsible for the conversations they are having with one another.

Implications for collaborators

Firstly, the processes discussed above suggest an immediate practical relevance for academics collaborating in a broad range of interaction settings where interdisciplinarity is sought. For collaborators themselves, awareness of silence has a dual purpose. In an academic context captivated with the verbal, having precise knowledge of the functions of silence can help elicit important information about partners' perspectives and needs. This, in turn, makes it easier to accurately estimate the feasibility of one's own goals (Krieger, 2001). By being able to understand the silences of fellow collaborators, people can reduce or avoid negative reactions, preventing possibilities for misunderstanding that result in parties growing apart. Additionally, it is crucial that collaborators understand the meaning of their own silences and their implications for shaping the course of interactions with others. Interdisciplinary collaboration is a dynamic, interactional process in which all participants share in the responsibility for its outcome. An essential skill is therefore seeing the big picture (Henriksen & Dayton, 2006), knowing how one's actions interact with, and influence, the behaviour of others and the entire process. Put differently, one must have the ability to understand one's actions from the perspective of the entire network. Although scientists are often aware of their own use of silence, they tend to overlook the unplanned effect of these silences on wider interaction contexts and on how interaction develops. With a better grasp of the effects of silence, scientists can understand the role of their own conversational silences in shaping the course of a collaboration, determining whether those silences are contributing positively to the course of interaction and, if not, providing insights into how they unwittingly perpetuate unproductive patterns (Ford, 1999). By identifying the meanings of their silence, collaborators can relate them to the broader issue of how to shape the course of collaboration, providing a basis for seeking out more suitable conversational strategies for developing and achieving common goals.

Implications for leadership

The results of this thesis are also relevant for leaders of interdisciplinary initiatives. During my research, I noticed that there is ample room for improvement in

everyday interdisciplinary leadership. As evidenced throughout this study, academic leaders involved in collaboration will often try to steer the process through a strong delivery style, charismatically explaining plans and strategy, in the process getting fixed on telling others about the right way forward or verbalizing distinct sides of the debate (Kaufmann, 2016), or they close off conversations and inquiry that move beyond entrenched positions by withdrawing from interaction.

Typically, strong leadership is identified as crucial to the success of interdisciplinary collaborations (Sonnewald, 2007; Shattock, 2010; Stokles et al., 2008). In more traditional scientific projects and research groups, leadership traits such as self-confidence, a strong professional attitude, and providing direction and vision are highly valued. However, being a successful leader of a research team or group does not necessarily mean that an individual is equally skilled at facilitating and supporting conversations that are intended to break down walls and silos. Leaders may lack the specific conversational skills of knowing how and when to address, articulate, or clarify dilemmas, or address sensitive issues and problems, failing to translate issues and problems across parties and motivate others to talk constructively about differences. As leadership plays an important role in interdisciplinary initiatives, it seems important to search for ways of leading that stimulate healthy conversations about difference (Kaufmann, 2016).

The dialogical leadership concept is helpful here (Isaacs, 1999). Dialogical leadership is a 'way of leading that consistently uncovers, through conversation, the hidden creative potential in any situation' (Isaacs, 1999, p. 2). According to Isaacs, this involves not just focusing on what is on the surface and can be seen, but also sensing the emerging potential of a situation, perceiving what is not yet visible and giving it voice. Only when leaders have an eye for uncertainties and unanswered questions are they able to work with, and restore, the balance in people's interactions, promoting collaboration and collegiality (Easley, 2008; Kaufmann, 2016). As studies in healthcare settings have shown, the presence of leaders with such dialogue skills can transform difficult conversations into vigorous, healthy debate, where no topic is verboten (Souba, Way, Lucey, Sedmak & Notestine, 2011, p. 1498).

Given the above, silence offers a new and valuable inroad into the hidden creative potential of conversations mentioned by Isaacs. Sensitivity to silences in a conversation can be a powerful catalyst for bringing unacknowledged or unclear elements into the conversation, generating new and constructive ways of making

tensions and dilemmas discussable. The collaborations described in this thesis could surely have benefited from having dialogical leaders with an eye for unspoken elements included in the process. Having a leader with strong dialogical skills at the table could often have stimulated participants to talk about dilemmas and how they might best be resolved, working more effectively towards the fulfilment of their shared purposes. But how does one evoke this potential and facilitate its articulation to ensure that it enhances creativity and collaboration?

Listening to silence: tapping into the creative potential of conversations

To unlock the creative potential of silence in conversation, it is important to develop the interrelated skills of recognizing these silences and knowing how to respond to them in dynamic interaction situations. Given the first point, the skill of listening is a crucial way in which this can be achieved. Listening is widely identified as a crucial but often neglected component of the conversational process, where it is associated with reflection, showing empathy, channelling reservoirs of anger, and building commitment and trust (Isaacs, 1999; Scharmer, 1998). As van Woerkum & Aarts (2011) have shown, listening makes it possible to connect to one another in deeper and more adequate ways.

In addition to the often-cited listening strategies, which consist of actively paying attention to messages and meanings of what others are saying (Scharmer, 1998), I want to add the ability to listen to what is not said as a crucial dialogical leadership strategy. In listening for silence, we pay attention to 'the relevant speech act "spoken" beneath the surface, in the interstices, around the corners of our ordinary perceptual frames, enabling a more careful reading (listening) of what we and our co-participants [...] are in fact saying, even when we are not speaking' (Mazzei, 2007, p. 632). When listening for silence, we turn our attention to less obvious aspects of interaction, which might include pauses, hesitations, lulls, omissions, repression, indrawn breaths, and so forth. Once we notice what is below the surface, it becomes possible to tap into the potential of what has not yet been fixed, concretized, and verbalized (Rappert & Balmer, 2015). Following Mazzei (2007) listening to silence 'provides an entrée to what is possible, plausible, knowable, askable, thinkable, considerable, or hearable. It moves beyond the current circumference of our consideration and invites us to enter that silent presence that, if listened for, listened to, heard, will lead to a more inclusive understanding of a multiplicity of meanings' (p. 640). Although such listening to

silence is much more difficult than paying attention to talk, applying it in everyday practice may serve as a valuable connecting mechanism for leaders operating in highly dynamic multi-stakeholder collaborations, anticipating difficult issues or problems and exploiting them to in order to arrive at better and more inclusive conversations.

The value of projective hearing

Regarding how this potential can be activated, van Woerkum and Aarts' (2011) notion of projective hearing offers some guiding points. In this approach, it is acknowledged that signals have more influence than messages (understanding, opinion formation, attitude change). These authors explain that a strong sense of what people consider important is unconsciously translated into a variety of signals (gestures, body motion, mimics, and so forth). By hearing these signals in daily interaction, leaders become aware of uncertainties and hesitations, and can within split-second precision timing adapt their reactions accordingly and respond reflectively. Leaders themselves become the main instrument of reflection, constantly giving off signals that match the desired path, attracting immediate responses and feedback that guide co-workers towards joint involvement in highly dynamic situations where a strong delivery style is often not effective. Thus, projective hearing means having 'an active ear, functioning like a radar, which picks up relevant movements out of innumerable potential ones, and by its connectedness with the nonverbal or verbal signals reinforces what has to be fostered or disapproves of, or neglects, what has to be weakened' (van Woerkum and Aarts, 2011, p. 172). Projective hearing, when combined with a clear vision of what is important, can be a strong organizing force, flexibly guiding people by subtly steering interactions.

When it is difficult for leaders to translate back their views of the silences that they have picked up when engaging with silences in multi-stakeholder collaboration, such a reflective strategy alerts equals to their use of silence and reminds them of their responsibility for the conversation. When interacting with equals, individual leaders often lack the power to act and tell others what to do. Collaborating partners may be overwhelmed when someone suddenly starts asking them to explain themselves, or to be quiet. In such a context, reflectively engaging with silence may offer another, subtler way to guide conversations. Rather than telling others what to do and say, picking up unspoken dimensions of conversation and

responding to them with subtle signals can provide subtle encouragements that keep conversations on the right track, for example subtly drifting to other matters and so discouraging people from adding more information to the conversation, or inducing them to talk by blinking an eye or inclining one's body to encourage a person to continue. Following a reflective approach, dialogical leaders are able to leverage speech and silence; this can bring about transformative shifts in the conversation that lead towards new and shared futures (Scharmer, 1998)

Implications for communication professionals

The value and relevance for support staff, such as science communication professionals, is that they can guarantee the conditions that facilitate more constructive conversations about dilemmas and problems; this also requires engaging with silence. In the past, science communication professionals have focused primarily on conveying scientific knowledge in more constructive ways to the general public, and more recently on driving scientific communication activities from a corporate communication perspective, training individual scientists to communicate their research in line with the overall strategic view that the university wants to convey (Van der Sanden & Osseweijer, 2011). When it comes to their role in supporting the communication of scientists participating in multi-stakeholder collaboration, science communication professionals (and their departments) need to consider their responsibility for facilitating more effective conversational processes. It would be advisable for them to widen their work domains to include not only constructing and sending messages, but also enhancing the quality of interdisciplinary conversation and responsibility. Leeuwis and Aarts (2011) propose three interrelated activities through which this can be achieved: encompassing multiple tasks and roles in the sphere of process preparation, supporting social learning, and dealing with dynamics of power and conflict.

The value of silence in process preparation

First of all, in relation to process preparation, communication professionals can assist in creating preconditions that benefit a more constructive speaking climate. Important here is designing the interaction process in such a way that speaking openly becomes easier, for example ensuring a group composition that favours

the articulation of visions, goals, and tasks (Sonnenwald, 2007). This can be done by, amongst other things, objectively mapping coalitions in early stages and ensuring that they do not consist merely of likeminded people, identifying and appointing speakers' roles and responsibilities, involving non-conformist participants, clarifying shared terminology, and setting realistic goals and timeframes.

With regard to process preparation, the case studies specifically underline the importance of creating safe and inclusive discussion spaces. A safe discussion atmosphere is essential for preventing defensive or self-protective reactions from participants when sensitive issues are being discussed, getting them to talk about uncomfortable differences and sensitive topics. Communication professionals can help to create such supportive and safe speaking environments, establishing communication ground rules, ensuring that conversations in asymmetric or defensive environments (e.g. only meeting at the faculty or department of one of the project parties) are avoided, and ensuring that there is enough time adequately to explore and negotiate differences.

Balancing silence and talk in conversation

Despite all of this, process preparation does not guarantee that participants will talk with one another in constructive ways. A further task can, therefore, be to assist in monitoring and guarding the course of conversations, helping to acknowledge and elicit silences that hinder or benefit change. This step requires effectively getting involved in the flow of interdisciplinary interaction and paying close attention to the silences that are used, carefully determining their reasons, functions, and effects. For instance, when silence indicates that there is an issue that is not being fully addressed or discussed during the process, communication staff can ask focused questions to elicit responses that take the group from the surface of a topic to its depth (Stanfield, 2002). When the meaning of silence is unclear, they can clarify it for participants or indicate that it may signal more than one meaning, so avoiding misunderstandings. In the China case (chapter 5), this could have helped to encourage the Dutch participants to check and adjust their interpretations and judgement, possibly avoiding misinterpretations that arose by their not being informed enough.

Making the undiscussable discussable

Although organizing reflection on silence in conversational dynamics can improve learning (Leeuwis & Aarts, 2011), sometimes more targeted action is needed with regard to silence. When this is the case, communication professionals can fulfil a role in addressing or even breaking the silence. One advantage of having communication members participate in interdisciplinary meetings is that they can question silent participants from their neutral role. They can take it upon themselves to raise sensitive issues that are difficult for participants to talk about openly, for instance because they could cause reputational damage or conflicted loyalties. This can help protect anonymity and reduce the problem of self-imposed silence. Also, when dominant or simply talkative participants dominate group discussions, communication professionals can discourage their dominant participation and ensure that everyone is heard. When there are 'elephants in the room', they can probe or explicate the interests or fears that keep them in place. The role of devil's advocate comes to mind here, in which the majority view is questioned by raising difficult issues and asking penetrating questions that nobody else wants to ask.

Implications for university interdisciplinary policy

My research also has implications for university policy and administrators developing and implementing collaborative efforts. Given the conclusions of my research, it would be advisable for university policymakers who are trying to break down the silos within and between universities to recognize that, in the new knowledge-based, networked economy, the ability to talk and think together is a vital source of competitive advantage and organizational effectiveness (Isaacs, 1999, p. 2). All too often, communication is added to strategic plans as an afterthought. In the context of my research for example, strategic plans defined communication in a narrow sense of external profiling involving such things as the organizing of press releases, arranging websites and social media, and developing communication plans and media strategy. It seems wise for university administrators to reconsider and broaden the scope of communication in the development of collaboration initiatives that position the university around today's social challenges, emphasizing the conversational complexity of these efforts in strategic plans and missions, and raising conversational responsibility to a core value.

To create such a conversation-friendly environment, administrators must ensure that interdisciplinary conversations are adequately supported and facilitated at the everyday interactional level. For this, it is important to make communication professionals part of the ongoing conversations that happen in the real world of collaborating, where they can monitor the conversation and intervene where and when necessary. This also requires creating the conditions for communication professionals to carry out their work, engaging them in difficult policy decisions, clarifying their roles and responsibilities, and giving off a powerful signal that they can assist in constructively bringing difficult issues to the table, ensuring that there is a good balance between speaking and silence.

In addition to professional communication staff, dialogical project leaders can be included who can proactively help in shaping constructive conversations to make participants interact and work together for the common good (Kaufmann, 2016). The inclusion of leaders with strong dialogue skills not only adds to the quality of interdisciplinary conversations, but also provides a form of role modelling: when respected academic leaders talk about difficult issues and problems, others will feel more comfortable raising issues and offering solutions. This ripple effect can be especially significant in academic settings, where being a good role model has a crucial place in leading others, moving them towards a greater sense of responsibility (Shattock, 2010).

The importance of conversational training

The design of interdisciplinary collaborative processes may finally be improved by training academics to have more constructive conversations. Many academics may not know exactly how to initiate talk about differences. Talking about differences is complex and involves its own set of skills. Hence, it is important to ensure that academics – especially those participating in interdisciplinary efforts – are adequately equipped to discuss and leverage differences in an open and constructive way. People can, for instance, benefit from hands-on training courses that teach them to talk constructively about differences, how to address complicated issues, how to be open without evoking resistance, how to encourage others to speak (Aarts, 2015; 1991; Isaacs, 1999). Training on difficult conversations must focus on silence so that academics come to understand silence as a critical part of the collaboration process.

Recommendations for future research

In presenting the functions and effects of silence, I have merely skimmed the surface. Silence is a huge and exciting topic and deserves much more research; this has led me to ask more questions than I can answer. Here, I offer some further avenues for research.

First of all, because the tendency to remain silent is not unique to technical universities, some of our findings may be applicable to other interdisciplinary projects. In an effort to better understand the broader role of silence in interdisciplinary collaboration, a comparative study of other types of universities and knowledge settings such as R&D departments could be informative. Such studies could show whether the presented silences are typical of socio-technical environments or apply more generally. The proposed silence typology could provide the basis for articulating a possible framework to guide future studies.

In addition to the presented functions of silence, I assume that more subtypes could be distinguished. Missing from my analysis, for instance, is the silence that allows for reflection. Although this has not received much attention in my thesis, it did play a role at various junctures and on various occasions, where it was used for clarification of motives, consideration of alternative possibilities for oneself, and alternative interpretations of what others are doing (or not) (Schuman, 2006). Moreover, I welcome researchers to add other relevant functions of silence and complement the typology.

Research questions could furthermore address the links among different functions of silence. This could help to reveal tipping points, where functional

uses of silence start to influence the course of interaction in unwanted ways. Such research might equally respond to Perlow and Repenning's (2009) call to 'identify the conditions under which silence moves from an isolated incident into a self-reinforcing norm' (p. 195). One way would be to examine the different types of silence in relation to the different types of interaction situations (from emails to workshops) in which collaboration occurs. Specifying these situations could provide a clearer view of how tipping points develop, revealing with more specificity the junctures when different silences occur in the process.

Methodological implications

Finally, my study leads to methodological questions about the study of silence. Although there is growing attention on theoretical work on the issue of silence, sound methodologies on the topic are still lacking (Jaworski, 1993). Studying silence is extremely challenging and creates many methodological difficulties. As Kendrick (2001) puts it: 'Silence is slippery; it shares a double elusiveness with language, for neither will permit of keeping' (p. 5).

Given this slippery nature of silence, new methods are needed to elicit vital data on its functioning and effects (Pinder & Harlos, 2001; Poland & Pederson, 1998). In my own research, I have used ethnographic methods, bringing into view some of the contrasting formal and informal conversations in which talk naturally occurred, articulating the silences in the phenomena under study. More substantial ethnographic work, with a strong emphasis on participant observation, could bring the functions and effects of silence in interdisciplinary collaboration more sharply into view. According to Rappert and Balmer (2015), silence has implications for how researchers write about the silences of our informants, and how they address the silences in their accounts, that is, how they reflect on the implications of what is left out of them. This observation brings me to my concluding words.

Final reflections

I would like to end with a few words on my own struggle with silence in undertaking research. The practice of social research gives rise to difficult dilemmas that involve silence. During the research process, I had to consider how to inform participants about my role as a researcher, whether or not to intervene in the collaborations that I was studying, and how to write up and report on sensitive issues in my research.

The first point concerns openness about my role as researcher. Ethnographic fieldwork requires that 'insider–outsider' tension is adequately managed during ongoing research. As an anthropologist, one typically studies foreign cultures in which one's outsider role is clear. However, when working nearer to home, as a researcher among researchers, one cannot be an outsider: people are more likely to consider you 'one of their own'. Such vague borders make it all the more important to inform people about the research that is being conducted. Although I have always tried to be open about my research objectives, emphasizing and explaining my ostensible impartiality as a researcher where and when I had the opportunity, this was rather challenging in multi-stakeholder settings. The fact that meetings took place under high time pressure (participants often did not hold an introductory round, assuming that everyone knew one another), but often did involve new actors, at times made it difficult to clarify my own role at the table, either because I could not find the room to say anything or out of fear of repeating myself. Silence imposed by the setting complicated the execution of my research. This

resulted in people sharing confidential information while unaware that there was a researcher present.

The second point concerns the field of tension between intervening or not in the collaboration process on the basis of confidential information. Silences can generate ethical dilemmas for researchers in their practice of studying other people (Poland & Pederson, 2006, p. 8). One such dilemma relates to sharing the research results with informants. On more than one occasion, I had to decide whether to intervene in the research process on the basis of confidential information, for instance about people who were deliberately imposing barriers that impeded things from functioning smoothly. Even though discussing this information with participants could perhaps have helped to handle these issues more appropriately and so would have benefited the course of the collaboration that I was studying, I chose not to say anything so as not to compromise my position as an impartial researcher in the field. This clearly marks a field of tension: remaining an observer or speaking out.

Following my research design, I shared my research results in a more general manner after the research was completed, informing key informants about outcomes and hosting a symposium at the university to debate the benefits and consequences of silence (Verouden & van der Sanden, 2016). Public discussion is valuable in its own right, but it is less suited to finding solutions for specific issues and assuming responsibility for actions and conversations. Were I to design a new research project, I would consider more intervention-oriented forms of ethnographic research that seek to use data to open up and intervene in ongoing collaboration practices (Zuiderent-Jerak & Bruun, 2009). More in line with my research focus, dialogue would be part of the research process, using the ethnographic data to engage researchers and informants in animated discussions about the course of the collaboration. In contrast to the use of case studies of different sub-fields that fitted the explorative aims of this study, this would demand in-depth ethnographic work in studying a smaller research community in which it is easier to build trust and rapport with study participants.

Finally, I grappled with the role of silence in reporting on the data. Writing about silence in high-stakes multi-actor settings requires confidentiality and anonymity of those being researched; reporting on silence may necessitate the concealment of sensitivities and interests. In my research, I have been especially careful not to publicly embarrass or compromise people or cast the university in

a negative light. This means that I did not always reveal what others told me or told each other and that I made the protagonists as anonymous as possible in my reporting, not providing supplementary information about the actors and their specific affiliations. Anonymity, however, leads to the silencing of information in favour of unrecognizability. Rather than providing a full ethnographic account of the research, which gains its strength from identification with informants and settings, I have written up the research findings by presenting fragments of conversational exchanges and contrasting statements taken from different interactions (see Rappert, 2010, p. 580). Even though this writing strategy aims to illustrate the lived experiences of participants, the absence of personal and context details most likely makes identification much more difficult.

Despite these limitations, I hope that my research conveys to the reader what it is like to collaborate in complex interdisciplinary settings, drawing attention to overlooked aspects of everyday experiences and their consequences. In the future, I would like to experiment with finding ways to actively highlight what is not being said, without losing sight of the particular quality of silence – a style of writing that Michael Taussig (1986, p. 10) has described as 'penetrating the veil while retaining its hallucinatory quality'. Rappert (2010) underlines that this requires moving beyond the 'ethics of exposure', in which anonymity and confidentiality are seen as research ethics and as barriers to representation (p. 572). Rappert instead suggests finding meaning in 'what is not considered, what cannot be determined, what is not allowed to be known, or what is deliberately concealed' (p. 2). According to Rappert, we should pay attention to research accounts that give prominence to the lived and emotional experiences of researchers by asking 'how what is absent could purposefully function as a creative aspect of qualitative writing' (p. 574). Although I have not dared to tread down this road, I believe with Rappert that such creative writing techniques can help to convey the alluring topic of interdisciplinary collaboration in new and exciting ways.

Silence, as this study shows, is a trap in many conversations and engagements; yet, it is also a most valuable tool of communication and of understanding in life, both personal and professional. Occasionally, I had to remind myself that although holding one's tongue may not lead to inter-university collaboration, research results, or the publishing of a PhD thesis, it may be a condition for insight. As is so beautifully expressed in literature's most famous essay on the subject, *On Silence* (1895, 19) by Nobel Prize laureate Maurice Maeterlinck: 'As gold

and silver are weighed in pure water, so does the soul test its weight in silence, and the words that we let fall have no meaning apart from the silence that wraps them round'.

References

Aarts, N. (2015). The Art of Dialogue [Inaugural lecture]. Retrieved from Wageningen University: http://www.wur.nl/upload_mm/f/8/d/998a1639-8df7-4130-81c6-8268b3c69d4c_Oratie%20Noelle%20Aarts.pdf

Aarts, N., van Lieshout, M., & van Woerkum, C. (2011). Competing Claims in Public Place: The Construction of Frames in Different Relational Contexts. In: W. A. Donohue, R. G. Rogan & S. Kaufmann (Eds.), *Framing Matters: Perspectives on Negotiation Research and Practice in Communication* (pp. 234-252) New York: Peter Lang.

Aarts, M. N. C., & van Woerkum, C. M. J. (2002). Dealing with Uncertainty in Solving Complex Problem. In C. Leeuwis & R. Pyburn (Eds.), *Wheelbarrows Full of Frogs: Social Learning in Rural Resource Management* (pp. 421-437). Assen: Koninklijke Van Gorcum.

Ai, J. (2006). Guanxi Networks in China: Its Importance and Future Trends. *China and World Economy, 14*(5), 105-118.

Akrich, M., Callon, M., & Latour, B. (2002). The Key to Success in Innovation. Part II: The Art of Choosing Good Spokespersons. *International Journal of Innovation Management, 6*(2), 207-225.

Anderson, H. (2012). The Second Essential Tension: on Tradition and Innovation in Interdisciplinary Research. *Topoi, 32*(1), 3-8.

Argyris, C. (1980). Making the Undiscussable and its Undiscussability Discussable. *Public Administration Review*, *40*(3), 205-21.

Argyris, C. (1994). Good Communication that Blocks Learning. *Harvard Business Review*, *72*(4): 77-85.

Argyris, C., Putnam, R., & Smith, D. M. (1985). *Action Science: Concepts, Methods, and Skills for Research and Intervention*. San Francisco: Jossey-Bass Publishers.

Aslani, S., Ramirez-Marin, J., Semnani-Azad, Z., Brett, J. M., & Tinsley, C. H. (2013). Dignity, Face, and Honor Cultures: Implications for Negotiation and Conflict. In M. Olekalns and W. Adair (Eds.), *Handbook of Research on Negotiation* (pp. 249-282). Northampton, MA: Edward Elgar.

Baker, A. C. (2010). *Catalytic Conversations: Organizational Communication and Innovation*. New York: M.E. Sharpe.

Baker, A. C., Jensen, P. J., & Kolb, D. A. (2002). *Conversational Learning: An Experiential Approach to Knowledge Creation*. Westport, Conn: Quorum Books.

Basso, K. H. (1970). "'To Give up on Words': Silence in Western Apache Culture." *Southwestern Journal of Anthropology*, 26(3), 213-230.

Bate, S. P. (1994). *Strategies for Cultural Change*. Oxford: Butterworth Heinemann.

Bate, P. (2004). The Role of Stories and Storytelling in Organizational Change Efforts: The Anthropology of an Intervention within a UK hospital. *Intervention Research*, 1(1), 27-42.

Bennett, J. M. (1993). Toward Ethnorelativism: A Developmental Model of Intercultural Sensitivity. In R. M. Paige (Ed.), *Education for the Intercultural Experience* (pp. 21-71). Yarmouth, ME: Intercultural Press.

Ben-Ze'ev, Ginio, E. R., & Winter, J. (2010). *Shadows of War: A Social History of Silence in the Twentieth Century*. Cambridge: Cambridge University Press.

Berger, C. R. (2004). Speechlessness: Causal Attributions, Emotional Features and Social Consequences. *Journal of Language and Social Psychology*, 23(2), 147-179.

Biagioli, M. (2012). From Ciphers to Confidentiality: Secrecy, Openness and Priority in Science. *The British Journal for the History of Science*, 45(2), 213-233.

Bijker, W. E. (2002) The Oosterschelde Storm Surge Barrier: A Test Case for Dutch Water Technology, Management, and Politics. *Technology and Culture*, 43(3), 569-584.

Bijker, W. E., Bal, R., & Hendriks, R. (2009). *The Paradox of Scientific Authority: The Role of Scientific Advice in Democracies*. Cambridge, MA: MIT Press. Blackman, D., & Sadler-Smith, E. (2009). The Silent and the Silenced in Organizational Knowing and Learning. *Management Learning*, 40(5), 569-585.

Blok, A. (1998). The Narcissism of Minor Differences. *European Journal of Social Theory*, 1(1), 33-56.

Blumer, H. (1969). *Symbolic Interactionism: Perspective and Method*. Englewood Cliffs: Prentice-Hall, Inc.

Böhm, D. (1990). *On Dialogue.* New York: Routledge.

Bok, S. (1989). *Secrets: On the Ethics of Concealment and Revelation*. New York: Vintage Books.

Bound, K., Saunders, T., Wilsdon, J., & Adams, J. (2013). *China's Absorptive State: Research, Innovation and the Prospects for China-UK Collaboration.* Project Report. London: Nesta.

Bouwen, R., & Hosking, D. M. (2000). Reflections on Relational Readings of Organizational Learning. *European Journal of Work and Organizational Psychology*, 9(2), 267-274.

Bourdieu, P. (1977). *Outline of a Theory of Practice*. Cambridge: Cambridge University Press.

Bradwell, P. (2009). *The Edgeless University*. London: Demos.

Bruijn, J. A., Adriaans, P. W., Hooymans, C. M., Klasen, E. C., & Morley, P. (2012). *China's Extended Hand. How Chinese and Dutch Knowledge Can Strengthen Each Other*. Dutch Advisory Council for Science and Technology Policy (AWT). Retrieved from http://www.awti.nl/upload/documents/publicaties/engels/a78uk.pdf

Brummett, B. (1980). Towards a Theory of Silence as a Political Strategy. *Quarterly Journal of Speech*, 66, 289-303.

Bruneau, T. (2009). Silence, Silences, and Silencing. In S. W. Littlejohn & K. A. Foss (Eds.), *Encyclopaedia of Communication Theory* (pp. 881-884). Los Angeles: Sage.

Bruneau, T. J., & Ishii, S. (1988). Communicative Silences: East and West. *World Communication, 17*, 1-33.

Bukvova, H. (2010). Studying Research Collaboration: A literature Review. *Working Papers on Informational Systems*, *10*(3). Available at http://sprouts.aisnet.org/10-3.

Carter, C., Clegg, S.R., & Kornberger, M. (2008). Strategy as practice? *Strategic Organization*, *6*(1), 83-99.

Casey, B. A. (1994). The Administration and Governance of Interdisciplinary Programs. In J. T. Klein & W. G. Doty (Eds.), *Interdisciplinary Studies Today. New Directions for Teaching and Learning*. San Francisco, CA: Jossey-Bass.

Castaán B., V. (2011). The Performance of Environmental Science in Research Teams. *Science as Culture*, *20*(3), 329-348.

Chambliss, W. J. (2011). *Police and Law Enforcement.* W. J. Chambliss, Ed. SAGE Publications.

Charmaz K. (2003). Grounded Theory: Objectivist and Constructivist Methods. In N. Denzin & Y. S. Lincoln (Eds.), *Strategies for Qualitative Inquiry* (pp. 249-291). Thousand Oaks, CA: Sage.

Chua, R. Y. J. (2012). Building Effective Business Relationships in China. *MIT Sloan Management Review,* 53(4), 27-33.

Clarke, A. E. (2005). *Situational Analysis: Grounded theory after the Postmodern Turn*. Thousand Oaks, CA: Sage.

Coleman, K., Jasperse, M. Herst, P., & Yielder, J. (2014). Establishing Radiation Therapy Advanced Practice in New Zealand. *Journal of Medical Radiation Sciences*, *61*, 38-44.

Coulthard, L. (2010). Listening to Silence The Films of Michael Haneke. *Cinephile*, *6*(1), 18-24.

Cummings, J. N., & Kiesler, S. (2005). Collaborative Research Across Disciplinary and Organizational Boundaries. *Social Studies of Science*, *35*(5), 703-722.

Croissant, J. L. (2014). Agnotology: Ignorance and Absence or Towards a Sociology of Things That Aren't There. *Social Epistemology*, *28*(1). 4-25.

Czarniawska, B., & Sevón, G. (1996). *Translating Organizational Change*. Berlin: Walter de Gruyter.

Daly, A. J. (2010). *Social Network Theory and Educational Change*. Cambridge: Harvard Education Press.

Dam-Mieras, R. van, Lansu, A., Rieckmann, M., & Michelsen, G. (2008). Development of an Interdisciplinary, Intercultural Master's Program on Sustainability: Learning from the Richness of Diversity. *Innovative Higher Education*, *32*(5), 251-264.

Dauenhauer, B. (1980). *Silence - The Phenomenon and its Ontological Significance.* Bloomington: Indiana University Press.

De Bruijn, H., & ten Heuvelhof, E. (2008). *Management in Networks: On Multi-Actor Decision Making*. London: Routledge.

De Bruijn, H., ten Heuvelhof, E., & in 't Veld, R. (2010). *Process Management: Why Project Management Fails in Complex Decision Making Processes*. London: Springer.

Dewulf, A., Gray, B., Putnam, L., Lewicki, R., Aarts, N., Bouwen, R., & Van Woerkum, C., (2009). Disentangling Approaches to Framing in Conflict and Negotiation Research: A Meta-Paradigmatic Perspective. *Human Relations*, *62*(2), 155-193.

Delft University of Technology. (2016). Roadmap 2020 TU Delft: Freedom to Excel.

Dennis, M. A. (1999). Secrecy and Science Revisited: From Politics to Historical Practice and Back. In: J. Peppy (Ed.), *Secrecy and Knowledge Production*. Cornell University Peace Studies Program, Occasional Paper #23.

Denzin, N. K. (1991). *Interpretive Ethnography: Ethnographic Practices for the 21st Century*. Thousand Oaks, CA: Sage.

Donaghey, J., N. Cullinane, T. Dundon, & Wilkinson, A. (2011). Reconceptualising Employee Silence: Problems and Prognosis. *Work, Employment & Society*, 25(1), 51-67.

Dörner, D. (1996). *The Logic of Failure: Why Things Go Wrong and What We Can Do To Make Them Right*. New York: Metropolitan Books.

Dyne, L. V., Ang, S., & Botero, I.C. (2003). Conceptualizing Employee Silence and Employee Voice as Multidimensional Constructs. *Journal of Management Studies*, 40(6), 1359-1391.

Elias, N. (1970). *Was ist Soziologie?* Munchen: Juventa Verlag.

Emerson, R., Fretz, R., & Shaw, L. (1995). *Writing Ethnographic Fieldnotes.* Chicago, IL: University of Chicago Press.

Ennew, C. T. & Fujia, Y. (2009). Foreign Universities in China: A Case Study. *European Journal of Education*, 44(1), 21-36.

Ephratt, M. (2008). The Functions of Silence. *Journal of Pragmatics*, 40(11), 1909-1938.

Epstein, J. L., & Sanders, M. G. (2006). Prospects for Change: Preparing Educators for School, Family, and Community Partnerships. *Peabody Journal of Education*, 81(2), 81-120.

Eisenberg, E. M. (1984). Ambiguity as strategy in organizational communication. *Communication Monographs*, 51, 227-242.

Evans, J. A. (2010). Industry Collaboration, Scientific Sharing, and the Dissemination of Knowledge. *Social Studies of Science*, 40(5), 757-791.

Fabian, J. (1991). Time and the Work of Anthropology: Critical Essays, 1971-1991. Chur: Harwood Academic Publishers

Farrell, M. P. (2001). *Collaborative Circles: Friendship Dynamics and Creative Work*. Chicago, IL: University of Chicago Press.

Fazackerley, A., & Worthington, P. (2007). *British Universities in China: The Reality Beyond the Rhetoric.* An Agora Discussion Paper. London: Agora: The Forum for Culture and Education.

Feller, I. (2006). Multiple Actors, Multiple Settings, Multiple Criteria: Issues in Assessing Interdisciplinary Research. *Research Evaluation*, 15, 5-15.

Ferguson, K. (2003). Silence: A Politics. *Contemporary Political Theory*, 2(1), 49-65.

Finholt, T. A. (2003). Collaboratories as a New Form of Scientific Organization. *Econ Innov New Techn*, 12(1), 5-25.

Flyvbjerg, B. (2006). Five Misunderstandings about Case-study Research. *Qualitative Inquiry*, 12(2), 219-245.

Fonseca, J. (2002). *Complexity and Innovation in Organizations*. London: Routledge.

Ford, J. D. (1999). Organizational Change as Shifting conversations. *Journal of Organizational Change Management,* 12(6), 480-500.

Foucault, M. (1978). *The History of Sexuality, Volume 1: An Introduction*. New York: Pantheon Books.

Frissen, P. (2016). *Het Geheim van de Laatste Staat*. Amsterdam: Boom.

Fujio, M. (2004). Silence During Intercultural Communication: A Case Study. *Corporate Communications,* 9(4), 331-338.

Gardezi, F., Lingard, L., Espin, S., Whyte, S., Orser, B., & Baker, G.R. (2009). Silence, Power and Communication in the Operating Room. *Journal of Advanced Nursing*, 65(7), 1390-1399.

Geissler, P. W. (2013). Public Secrets in Public Health: Knowing not to Know while Making Scientific Knowledge. *American Ethnologist*, 40(1), 13-34.

Gendron, R. (2011). Thee Meanings of Silence during Conflict. *Journal of Conflictology*, 2(1), 1-7.

Gibbons, M., Limoges, C., Nowotny, H., Schwartzman, S., Scott, P., & Trow, M. (1994) *The New Production of Knowledge: The Dynamics of Science and Research in Contemporary Societies*. London: Sage.

Gill, R (2009) Breaking the Silence: The Hidden Injuries of Neo-Liberal Academia. In R. Flood & R. Gill (Eds.) *Secrecy and Silence in the Research Process: Feminist Reflections.* London: Routledge.

Gherardi, S., & Davide, N. (2002). Learning in a Constellation of Interconnected Practices: Canon or Dissonance? *Journal of Management Studies*, 39(4), 419-436.

Gladwell, M. (2000). *The Tipping Point: How Little Things Can Make a Big Difference*. Boston: Little, Brown.

Goffman, E. (1959). *The Presentation of Self in Everyday Life*. New York: Anchor Books.

Goffman, E. (1969). *The Presentation of Self in Everyday Life*. London: Penguin.

Gray, Barbara. (1989). *Collaborating: Finding Common Ground for Multiparty Problems*. San Francisco: Jossey-Bass.

Grice, H. P. (1989). *Studies in the Way of Words*. Cambridge: Harvard University Press.

Gusterson, H. (1998). *Nuclear Rites: A Weapons Laboratory at the End of the Cold War*. Berkeley: University of California Press.

Hackett, E. J. (2005). Introduction to the Special Guest-Edited Issue on Scientific Collaboration. *Social Studies of Science*, 35(5), 667-671.

Hackett, E. J. (2005). Essential Tensions: Identity, Control, and Risk in Research. *Social Studies of Science*, 35(5), 787-826.

Hall, E. T. (1959) *The Silent Language*. New York: Anchor Books.

Hammersley M., & Atkinson P. (2007) *Ethnography: Principles in Practice*. Routledge, London.

Hardwig, J. (1986). Epistemic Dependence. *Journal of Philosophy*, 82(7), 335-349.

Hanson, M.P. (2006). Make-or-break Roles in Collaboration Leadership. In S. Schuman (Ed.), *Creating a Culture of Collaboration: The International Association of Facilitators Handbook* (pp. 129-147). San Francisco, CA: Jossey-Bass.

Herbig, P., & Martin, D. (1998) Negotiating with Chinese: A Cultural Perspective. *Cross Cultural Management*, 5(3), 42-56.

Henriksen, K., & Dayton, E. (2006). Organizational Silence and Hidden Threats to Patient Safety. *Health Services Research*, 4, (4 Pt 2), 1539-1554.

Hicks D., & Katz S. (1996). Where is Science Going? *Science, Technology and Human Values*, 21(4), 379-406.

Hilgartner, S. (2000). *Science on Stage: Expert Advice as Public Drama*. Stanford, CA: Stanford University Press.

Hilgartner, S. (2012). Selective Flows of Knowledge in Technoscientific Interaction: Information Control in Genome Research. *The British Journal for the History of Science*, 45(2), 267-280.

Hirsch, W. Z., & Weber, l. (Eds.) (2002). *As the Walls of Academia are Tumbling Down*. London: Economica.

Hofstede, G. (1991) *Cultures and Organizations: Software of the Mind*. London: McGraw-Hill.

Holley, K. A. (2009). Interdisciplinary Strategies as Transformative Change in Higher Education. *Innovative Higher Education*, 34, 331-344.

Hwang, A., Ang, S., & Francesco, A. M. (2002) The Silent Chinese: The influence of Face and Kiasuism on Student Feedback-Seeking Behaviours. *Journal of Management Education*, 26(1), 70-98.

Isaacs, W. (1999). *Dialogue and the Art of Thinking Together*. New York: Doubleday.

Isaacs, W. (1999). Dialogical leadership. *The Systems Thinker*, *10*(1), 1-5.

Jacobs, C., & David, C. (2005). Sound from silence: On listening in organizational learning. *Human Relations*, *58*(1), 115-138.

Janis, I. L. (1982). *Groupthink*. Boston: Houghton Mifflin.

Jarzabkowski, P., & Seidl, D. (2008). The Role of Meetings in the Social Practice of Strategy. *Organization Studies*, *29*(11), 1391-1426.

Jaworski, A. 1997. *Silence: Interdisciplinary Perspectives*. A. Jaworski (Ed.). Berlin: Mouton de Gruyter.

Jaworski, A. (1989). Formulaic Silence. *Glossologia*, *8*(8), 169-176.

Jaworski, A. (1993). *The Power of Silence: Social and pragmatic perspectives*. Newbury Park, CA: Sage Publications.

Jaworski, A. (2005). Introduction: Silence in Institutional and Intercultural Contexts. *Multilingua - Journal of Cross-Cultural and Interlanguage Communication*, *24*(8), 1-6.

Jeffery, P. (2003). Smoothing the Waters: Observations on the Process of Cross-disciplinary Research Collaboration. *Social Studies of Science*, *33*(4), 539-562.

Jenkins, S. (2000) Cultural and Linguistic Miscues: A Case Study of International Teaching Assistant and Academic Faculty Miscommunication. *International Journal of Intercultural Relations*, *24*(4), 477-501.

Johannesen, R. L. (1974). The Functions of Silence: A Plea for Communication Research. *Western Journal of Speech Communication*, *38*(1), 25-35.

Jong, P., & van den Brink, M. (2013). Between Tradition and Innovation: Developing Flood Risk Management Plans in the Netherlands. *Journal of Flood Risk Management*, 1-9.

Kaats, E., & Opheij, W. (2014). *Creating Conditions for Promising Collaboration: Alliances, Networks, Chains, Strategic Partnerships*. Berlin: Springer.

Katz, J. S., & Martin, B. R. (1997). What Is Research Collaboration? *Research Policy*, *26*(1), 1-18.

Kauffman, J. Leading in the Middle: Conversations and Dialogical Leadership in Higher Education [PhD thesis, Bowling Green State University]. Retrieved from: https://etd.ohiolink.edu/!etd.send_file?accession=bgsu1458908710&disposition=inline

Klein, J. T. (1990). *Interdisciplinarity: History, theory, and practice.* Detroit: Wayne State University Press.

Klein, J., & Newell, W. (1998). Advancing Interdisciplinary Studies. In W. Newell (Ed.), *Interdisciplinarity: Essays from the literature* (pp. 3-22). New York: College Board.

Klotzbücher, S. (2014). Western–Chinese Academic Collaboration In the Social Sciences. *Journal of Current Chinese Affairs*, *43*(2), 7-12.

Knight, L. (2002). Network Learning: Exploring Learning by Interorganizational Networks. *Human Relations*, *55*(4), 427-454

Kolb, D. M., & Bartunek, J. M. (1992). *Hidden Conflict in Organizations: Uncovering Behind-the-Scenes Disputes*. Newbury Park, CA: Sage.

Krieger, S. (2001) A Time to Keep Silent and a Time to Speak: The Functions of Silence in the Lawyering Process. *Oregon Law Review*, *80*, 199-266.

Krippendorff, K. (2008). Social Organizations as Reconstitutable Networks of Conversation. *Cybernetics and Human Knowing*, *15*(3-4), 149-161.

Lebra, T.S. (1987). The Cultural Significance of Silence in Japanese Communication. *Multilingua*, *6*(4), 343-357.

Leeuwis, C., & Pyburn, R. (2002). Social Learning in Rural Resource Management. In C. Leeuwis & R. Pyburn (Eds), *Wheelbarrows Full of Frogs: Social Learning in Rural Resource Management* (pp. 421-437). Assen: Koninklijke Van Gorcum.

Leeuwis, C., & Aarts, N. (2011). Rethinking Communication in Innovation Processes: Creating Space for Change in Complex Systems. *Journal of Agricultural Education and Extension*, 17(1), 21-36.

Lemak, A. (2012) *Silence, Intercultural Conversation, and Miscommunication*. Unpublished thesis. University of Toronto.

Lewis, L., Isbell, M. G., & Koschmann, M. (2010). Collaborative Tensions: Practitioners' Experiences of Interorganizational Relationships. *Communication Monographs*, 77(4), 460-479.

Liefner, I. (2003). Funding, Resource Allocation, and Performance in Higher Education Systems. *Higher Education*, 46(4), 469-489.

Li-Hua, R. (2007). Knowledge Transfer in International Educational Collaboration Programme: The China Perspective. *Journal of Technology Management in China*, 2(1), 84-97.

Luhmann, N. (1994). Speaking and Silence. *New German Critique*, 61, 24-37.

Luo, Y. (1997). Guanxi: Principles, philosophies, and Implications. *Human Systems Management*, 16(1), 43-51.

Mackendrick, K. Immemorial Silence. (2001). New York: State University of New York Press. Maeterlinck, M. (1903). 'Silence', in *The Treasure of the Humble.* New York: Dodd, Mead & Company/ London: George Allen, Ruskin House. Translation by Alfred Sutro.

Maturana, H.R, & Varela, F.G. (1988). *The Tree of Knowledge*. Boston and London: Shambhala.

Mazzei, L. A. (2004). Silent Listenings: Deconstructive Practices in Discourse-Based Research. *Educational Researcher*, 33(2), 26-34

Mazzei, L. A. (2007). Toward a problematic of silence in action research. *Educational Action Research*, 15(4), 631-642.

McFadden, K. L., Chen, S. J., Munroe, D. J. Naftzger, J. R., & Selinger, E. M. (2010). Creating an Innovative Interdisciplinary Graduate Certificate Program. *Innovative Higher Education*, 36(3), p. 161-176.

Mellor, F. (2017). The Communicative Functions of Silence in Science. In F. Mellor & S. Webster (Eds.), *The Silences of Science: Gaps and Pauses in the Communication of Science* (pp.1-27). London: Routledge.

Mellor, F., & Webster, S. (Eds.) (2016). *The Silences of Science: Gaps and Pauses in the Communication of Science*. London: Routledge.

Ministry of Education, Culture and Science of the Government of the Netherlands. (2014) *Vision for Science 2025: Choices for the Future*. Den Haag, the Netherlands.

Moore, F. (2011). Holistic Ethnography: Studying the Impact of Multiple National Identities on Post-Acquisition Organizations. *Journal of International Business Studies*, 42(5), 654-671.

Morrison, E. W., & Milliken, F. J. (2000). Organizational Silence: A Barrier to Change and Development in a Pluralistic World. *Academy of Management Review*, 25(4), 706-725.

Munthe, C., & Welin, S. (1996). The Morality of Scientific Openness. *Science and Engineering Ethics*, 2(4), 411-28.

Nakane, I. (2007). *Silence in Intercultural Communication: Perceptions and performance*. Amsterdam: John Benjamins Publishing Company.

Nicolini, D. (2010). Medical Innovation as a Process of Translation: A Case from the Field of Telemedicine. *British Journal of Management*, *21*, 1011-1026.

Nussbaum, M. C. (2006). *Frontiers of Justice. Disability, Nationality, Species Membership*. Cambridge, MA: Harvard University Press.

OECD. (2003). *Networks of Innovation Towards New Models for Managing Schools and Systems*. Paris: OECD Publication Service.

Olsen, T. (2003). *Silences*. New York: Feminist Press.

Oreskes, N., & Conway, E. M. (2010). *Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming*. London: Bloomsbury Press.

Oswick, C., P Anthony, Keenoy, T. & Mangham, I. L. (2000). A Dialogic Analysis of Organizational Learning. *Journal of Management Studies*, *37*(6), 887-901.

Pahl-Wostl, C., Craps, M., Dewulf, A., Mostert, E., Tabara, D., & Taillieu, T. (2007). Social Learning and Water Resources Management. *Ecology and Society*, *12*(2). Available at http://www.ecologyandsociety.org/vol12/iss2/art5/.

Panteli, N., & Fineman, S. (2005). The Sound of Silence: The Case of Virtual Team Organising. *Behaviour and Information Technology*, *24*(5), 347-352.

Patterson, K., Grenny, J., McMillan, R., & Switzler, A. (2012). *Crucial Conversations: Tools for Talking when the Stakes are High*. New York: McGraw-Hill.

Pinder, C. C., & Harlos, K. P. (2001). Employee Silence: Quiescence and Acquiescence as Responses to Perceived Injustice. *Research in Personnel and Human Resources Management*, *20*, 331-369.

Pearce, W. B., & Littlejohn, S. W. (1997). *Moral Conflict. When Social Worlds Collide.*Thousand Oaks: Sage Publications.

Pearce, B., & Pearce, K. A. (2003). Taking a Communication Perspective On Dialogue. In R. Anderson, L. A. Baxter & K. N. Cissna (Eds.), *Dialogue: Theorizing Difference in Communication Studies* (pp. 39-56). Thousand Oaks, CA: Sage.

Perlow, L. A., & Repenning, N. P. (2009). The Dynamics of Silencing Conflict. *Research in Organizational Behaviour*, *29*, 195-223.

Poland, B., & Pederson, A. (2006). Reading Between the Lines: Interpreting Silences in Qualitative Research. *Qualitative Inquiry, 4*(2), 293-321.

Polanyi, M. (1958). *Personal Knowledge: Towards a Post-Critical Philosophy*. Chicago: University of Chicago Press.

Pretty, J. N. (1995). Participatory Learning for Sustainable Agriculture. *World Development*, *23*(8), 1247-1263

Proctor, R., & Schiebinger, L. L. (2008). *Agnotology: The Making and Unmaking of Ignorance.* Stanford: Stanford University Press.

Rappert, B. (2007). *Biotechnology, Security and the Search for Limits*: An inquiry into Research Methods. New York: Palgrave Macmillan.

Rappert, B. (2010). Revealing and Concealing Secrets in Research: The Potential for the Absent. *Qualitative Research*, *10*(5), 571-587.

Rappert, B., & Balmer, B. (2015). *Sensing Absence: How to See What Isn't There in the Study of Science and Security.* New York: Palgrave MacMillian.

Resnik, D. B. (2006). Openness versus Secrecy in Scientific Research. Episteme, *2*(3), 135-147.

Rhoades, G. (2002). Who's Doing It Right? Strategic Activity in Public Research Universities. *Review of Higher Education*, 24(1), 41-66.

Rogers, E.M. 1962. *Diffusion of Innovations*. New York: Free Press.

Rothwell, G. R., & J. Norman Baldwin. 2007. "Ethical Climate Theory, Whistle-Blowing, and The Code of Silence in Police Agencies in the State of Georgia. *Journal of Business Ethics*, 70(4) 341-361.

Rosen, S., & Tesser, A. (1970). On reluctance to communicate undesirable information: the MUM effect, *Sociometry*, 33, 253-263.

Sa, C. (2007). Interdisciplinary Strategies in US Research Universities. *Higher Education*, 55(5), 537-552.

Schuman, S. (2006). *Creating a Culture of Collaboration: The International Association of Facilitators Handbook*. San Francisco, CA: Jossey-Bass.

Scollon, R., & Wong-Scollon, S. (1990) Athabaskan-English Interethnic Communication. In D. Carbaugh (Ed.), *Cultural Communication and Intercultural Contact* (pp. 259-286). Hillsdale, NJ: Lawrence Erlbaum.

Shapin, S. (2008). *The Scientific Life: A Moral History of a Late Modern Vocation*. Chicago:University of Chicago Press.

Scharmer, C. O. (2009). *Theory U: Leading from the Future as it Emerges*. San Francisco: Berre-Koehler.

Schuman, S. (2006). *Creating a Culture of Collaboration: The International Association of Facilitators Handbook*. San Francisco, CA: Jossey-Bass.

Shattock, M. (2010). *Managing Successful Universities*. Berkshire: McGraw-Hill House.

Shaw, P. (2002). *Changing Conversations in Organizations: A Complexity Approach to Change*. London: Routledge.

Sheriff, R. (2000). Exposing Silence as Cultural Censorship: A Brazilian Case. *American Anthropologist*, 102(1), 114-132.

Shrum, W., Genuth, J., & Chompalov, I. (2007). *Structures of Scientific Collaboration*. Cambridge: The MIT Press.

Sifianou, M. (1997). Silence and Politeness. In A. Jaworski (Ed.), *Silence: Interdisciplinary Perspectives* (pp. 63-84). New York: Mouton de Gruyter.

Simakova, E. (2012) Collaboration Talk: The folk Theories of Nano Research. *Science as Culture*, 21(2),177-203.

Simmel, G. (1906). The Sociology of Secrecy and Secret Societies. *American Journal of Sociology*, 11(4), 441-498)

Stilgoe, J., Owen, R., & Macnaghten, P. (2013). Developing a Framework for Responsible Innovation. *Research Policy*, 42(9), 1568-1580.

Sonnenwald, D. H. (2007) Scientific Collaboration. *Annual Review of Information Science and*

Thomson, A. M., & Perry, L. P. (2006). Collaboration Processes: Inside the Black Box. *Public Administration Review*, 66(1), 20-32.

Souba, W., Way, D., Lucey, C., Sedmak, D., & Notestine, M. (2011). Elephants in Academic Medicine. *Academic Medicine*, 86(12), 1492-1499.

Spencer-Oatey, H., & Xing, J. (2005). Silence in an Intercultural Business Meeting: Multiple Perspectives and Interpretations. *Multilingua*, 24(1/2), 55-74.

Star, S. L., & Bowker, G. C. (2007). Enacting Silence: Residual Categories as a Challenge for Ethics, Information Systems, and Communication. *Ethics and Information Technology*, *9*(4) 273-280.

Stokols, D., Misra, S., Moser, R., Hall, K., & Taylor, B. K. (2008). The Ecology of Team

Science: Understanding Contextual Influences on Transdisciplinary Collaboration. *American Journal of Preventive Medicine*, 35(2), 96-115.

Stanfield, R. B. (2002). *The Workshop Book: From Individual Creativity to Group Action*. Toronto: Canadian Institute of Cultural Affairs.

Stead, G.B., & Harrington, T.F. (2000). A Process Perspective of International Research Collaboration. *The Career Development Quarterly, 48*(4), 323-331.

Stokols, D., Misra, S., Moser, R. P., Hall, K. L., & Taylor, B. K. (2008). The Ecology of Team

Science: Understanding Contextual Influences on Transdisciplinary Collaboration. *American Journal of Preventive Medicine*, 35(2 Suppl.), 96-115.

Stone, D., Patton, B., & Heen, S. (1999). *Difficult Conversations: How to Discuss What Matters Most*. New York: Penguin.

Strauss, A. (1978). *Negotiations*. San Francisco, CA: Jossey-Bass. Tannen, D. (1984) Silence: Anything but. In D. Tannen & M. Saville-Troike (Eds.), *Perspectives on Silence* (pp. 93-111). Norwood, NJ: Ablex. Taussig, M. T. (1986). *Shamanism, Colonialism, And The Wild Man: A Study in Terror And Healing*. Chicago: University of Chicago Press.

Taylor, P., & Szteiter, J. (2012). *Taking Yourself Seriously: Processes of Research and Engagement*. Arlington, MA: The Pumping Station.

Tett, G. (2010). Silos and Silences: Why So Few People Spotted the Problems in Complex Credit and What That Implies for the Future. *Financial Stability Review*, (14), 121-129.

Thorp, H., & Goldstein, B. (2010). *Engines of Innovation: The Entrepreneurial University in the Twenty-first Century*. Chapel Hill: The University of North Carolina Press.

Traweek, S. (1992). *Beamtimes and Lifetimes: The World of High Energy Physicists*. Cambridge, MA: Harvard University Press.

Tucker, A., & Edmondson, A. (2003). Why Hospitals Don't Learn from Failures: Organizational and Psychological Dynamics that Inhibit System Change. *California Management Review*, *45*, 55-72. Turner, M. E., & Pratkanis, A. R. (1998). A Social Identity Maintenance Model of Groupthink. *Organizational Behaviour & Human Decision Processes, 73*(2-3), 210-235.

Turner, K., Benessaiah, K., Warren, S., & Iwaniec, D. (2015). Essential Tensions in Interdisciplinary Scholarship: Navigating Challenges in Affect, Epistemologies, and Structure in Environment–society Research Centres. *Higher Education*, *70*(4), 649-665.

Turow, J. (1994). Hidden Conflicts and Journalistic Norms: The Case of Self-coverage. *Journal of Communication*, *44*(2), 29-46.

Van Assche, K., & Costaglioli, F. (2012). Silent Places, Silent Plans: Silent Signification and the Study of Place Transformation. *Planning Theory*, *11*(2), 128-147.

Van der Sanden, M. C. A., & Osseweijer, P. (2011). Effectively Embedding Corporate Science Communication in Academia: A Second Paradigm Shift? In D. J. Bennett & R. C. Jennings (Eds.), *Successful Science Communication: Telling it Like it is* (pp. 423-442). Cambridge: Cambridge University Press.

Van Dyne, L., Ang, S., & Botero, U. C. (2003). Conceptualizing Employee Silence and Employee Voice as Multidimensional Constructs. *Journal of Management Studies*, *40*(6), 1359-1391.

Van Herzele, A., & Aarts. N. (2013). 'My forest, my Kingdom'– Self-referentiality as a Strategy in the Case of Small Forest Owners Coping with Governmental Regulations. *Policy Sciences*, 46(1), 63-81.

Van Oortmerssen, L. A., van Woerkum, C. M. J., & Aarts, N. (2014). The visibility of trust: Exploring the Connection between Trust and Interaction in a Dutch Collaborative Governance Boardroom. *Public Management Review*, 16(5), 666-685.

Van Rijswoud, E. (2013). Public Faces of Science: Experts and Identity Work in the Boundary Zone of Science, Policy and Public Debate, Doctoral dissertation, Radboud University.

Van Manen, M, (1990). *Researching Lived Experience: Human Science for an Action Sensitive Pedagogy*. Ontario: The University of Western Ontario Press

Van Woerkum, C. M. J., & Aarts, M. N. C. (2008). The Orientation of Organizations to Their Environments: Functions of the Unconscious Mind. *Journal of Public Relations Research*, 20(2), 180-206.

Van Woerkum, C. & Aarts, N. (2011). Organizing by Projective Hearing: The Active Use of a Passive Sense. *International Journal of Strategic Communication,* 5(3), 171-182.

Vermeir, K., & Margóscy, D. (2012). States of Secrecy: An Introduction. *The British Journal for the History of Science*, 45(02), 1-12.

Verouden, N. W., van der Sanden, C. A., & Aarts, N. (2016). Silence in Interdisciplinary Research Collaboration. *Science as Culture,* 25(2), 264-288.

Vreugdenhil, H., & Wijermans, F. (2012). De Beleidsarena van het Deltaprogramma. *Water Governance*, 6, 30-38.

Vaughan, D. (1998). Rational Choice, Situated Action, and the Social Control of Organizations. *Law and Society Review*, 32(1), 23-61.

Wajnryb, R. (2001). *The Silence: How Tragedy Shapes Talk*. Sydney: Allen and Unwin.

Wals, A. E. J. (2007). Introduction. In A. E. J. Wals (Ed.) *Social Learning: Towards a Sustainable World* (17-32). Wageningen: Wageningen Academic Publishers.

Wenger, E. (2000). Communities of Practice and Social Learning Systems. *Organization,* 7(2), 225-246.

Wenger, E. C., McDermott, R., & Snyder, W. C. (2002). *Cultivating Communities of Practice: A Guide to Managing Knowledge*. Cambridge: Harvard Business School Press.

Wieland, M. (1991). Turn-Taking Structure as a Source of Misunderstanding in French-American Cross-Cultural Conversation. *Pragmatics and Language Learning,* 2, 101-118.

Wiering, M., & Immink, I. (2006). When Water Management Meets Spatial Planning: A Policy Arrangements Perspective, Environment and Planning. *Government and Policy*, 24(3), 423-438.

Winter, J. (2009). Thinking about Silence. In E. Ben-Ze'ev, R. Ginio & J. Winter (Eds.), *Shadows of War: A Social History of Silence in the Twentieth Century* (3-32). Cambridge: Cambridge University Press.

Xu, H., & Morris, L.V. (2007). Collaborative Course Development for Online Courses. *Innovative Higher Education*, 32(1), 25-47.

Yanow, D. (2006). Thinking Interpretively: Philosophical Presuppositions and the Human Science. In: D. Yanow & P. Schwartz-Shea (Eds.), *Interpretation and Method: Empirical Research Methods and the Interpretive Turn* (5-26). New York: Amon.

Yanow, D. (2006). Thinking Interpretively: Philosophical presuppositions and the Human Sciences. In D. Yanow & P. Schwartz-Shea (Eds.), *Interpretation and Method: Empirical Research Methods and the Interpretive Turn* (pp. 5-26). New York: M.E. Sharpe.

Yanow, D. (2014). Interpretive Analysis and Comparative Research. In I. Engeli, A. C. Rothmayr, & C. Allison (Eds.), *Comparative Policy Studies: Conceptual and Methodological Challenges* (pp. 131-159). Houndsmill, Basingstoke: Palgrave Macmillan

Yum, J. O. (1988). The Impact of Confucianism on Interpersonal Relationships and Communication Patterns in East Asia. *Communication Monographs,* 55(4), 374-388.

Zerubavel, E. (2006). *The Elephant in the Room: Silence and Denial in Everyday Life*. Oxford: Oxford University Press.

Zhu, Y., McKenna, B., & Sun, Z. (2007). Negotiating with Chinese: Success of initial meetings is the key. *Cross Cultural Management, 14*(4), 354-364.

Zuiderent-Jerak, T., & Jensen, Casper., B. (2007). Unpacking 'Intervention' in Science and Technology Studies. *Science as Culture*, *16*(3), 227-235.

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Curriculum vitae

Nick Verouden was born on 17 December 1975 in Amsterdam. He studied cultural anthropology at the University of Amsterdam from 1998-2004 (Cum laude). After working as researcher and teacher at the University of Amsterdam Health Services and VU medical centre (department of medical humanities) on the topics of health communication and water culture, he started his PhD research at the department of Science Communication of the Delft University of Technology (TU Delft). Here he studied conversations among stakeholders in complex (international) collaborations around socio-technological issues, paying particular attention to the significance of issues that are not discussed. In 2016, he worked as a postdoc at Wageningen University on dialogue in 21st century governance context. Currently, he coordinates the Design Across Cultures program of the Digital Society School of the Amsterdam University of Applied Sciences (HvA) where multidisciplinary teams around the world work together simultaneously on societal challenges from different (local and cultural) contexts. Over the years he has published in academic and popular journals on several topics such as silence, collaboration, health communication, and the socio-cultural dimensions of water and water management. He is also the co-editor of several Dutch-language anthologies of international poetry.

Selected publications

Verouden, N. W., van der Sanden, M. C. A van der, & Aarts, N. (2018). Silence in Intercultural Collaboration: A Sino-Dutch Research Centre. *Advances in Applied Sociology*, *8*(2), 125-151.

Verouden, N. W., van der Sanden, M. C. A van der, & Aarts, N. (2016). Silence in Interdisciplinary Research Collaboration: Not Everything Said is Relevant, Not Everything Relevant is Said. *Science as Culture*, 25(2), 264-288.

Verouden, N. W., van der Sanden, M. C. A., & Aarts, N. (2016). Engineers at the Patient's Bedside: The Case of Silence in Inter-Institutional Educational Innovation. In: F. Mellor, & S. Webster (Eds.), *The Silences of Science: Gaps and Pauses in the Communication of Science*. London: Routledge.

Verouden, N. W. (2016). *Communication and Social Learning: The Significance of Silence*. In: Maarten M. C. A. van der Sanden, & M. J. de Vries (Eds.), *Science and Technology Education and Communication: Seeking Synergy* (pp. 87-107). Boston: Sense Publishers.

Verouden, N. W., & Sanden, MCA van der. (2016). Is Silence Golden? Silence in Interdisciplinary Collaboration between Scientists. Journal of Science Communication, 15(05), 1-4

Verouden, N. W., van der Sanden, M. C. A, & Aarts, N. (2016) Stilte is de Grondtoon van het Gesprek. *Communicatie Magazine*, 1, 46-48

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In our focus on spoken conversation we tend to forget that there are also things not said. In failing to acknowledge these silences, much of what is significant may be overlooked. This book presents the findings of ethnographic fieldwork in intra- and inter-university collaboration, including that of Dutch and Chinese scientists. It also offers theoretical insights into the connection between silence and social learning. Silence is analysed in four functions. Understanding these has major practical implications for improving the ways in which we work together.