AAPG2021	ACCENT		PRCE
Coordinated by:	Karim MIGNONAC, TSMR	Duration: 48months	Requested: 648k€
8.13. Industrie et usine du futur: Homme, organisation, technologies			

The Augmented Call-Center:

A laboratory for the cognitive, ethical and organizational impact of voice technology in the new service industries

Summary table of persons involved in the project:

Partner	Name	First name	Current position	Role & responsibilities	Involvement
TSMR (Management science Team)	**Mignonac**	**Karim**	Permanent (Full professor): Management Science	Project Coordinator. Scientific leader, Partner 1. Research in WP3.1 and WP4.2	24 p.month
TSMR (Management science Team)	**Boujendar**	**Sarah**	Permanent (MCF): Management Science	Research in WP3.1, WP3.2 and WP4.2	24 p.month
TSMR (Management science Team)	To be recruited		Non-permanent (Postdoc): Management Science	Research in W3.1, WP3.2 and WP4.2	24 p.month
TSMR (Ethics Team)	**Bonnefon**	**Jean-François**	Permanent (DR CNRS): Cognitive science	Scientific leader, Team B Research in WP 3.4	10 p.month
TSMR (Ethics Team)	To be recruited		Non-permanent (Postdoc): Cognitive science	Research in WP3.4	12 p.month
FEMTO-ST (Cognitive Science Team)	**Aucouturier**	**Jean-Julien**	Permanent (DR CNRS): Cognitive science	Scientific leader, Partner 2 Research in WP2.3, WP4.1-2	18 p.month
FEMTO-ST (Cognitive Science Team)	To be recruited		Non-permanent (Postdoc): Cognitive science	Research in WP2.3 and WP4.1-2	18p.month
FEMTO-ST (Sociology Team)	**Rey**	**Benedicte**	Permanent (MCF): Sociology	Scientific leader, Team B Research in WP 3.3	8 p.month
FEMTO-ST (Sociology Team)	**Curci**	**Ylenia**	Permanent (MCF): Economics	Research in WP3.1 and WP4.1	8 p.month
FEMTO-ST (Sociology Team)	**Triclot**	**Mathieu**	Permanent (MCF): Philosophy	Research in WP3.3 and WP3.4	4 p.month
FEMTO-ST (Sociology Team)	**Simoncini**	**Nicolas**	Permanent (MCF): Sociology	Research in WP3.3	3 p.month
FEMTO-ST (Sociology Team)	To be recruited		Non-permanent (Postdoc): Sociology	Research in WP3.3	18p.month
Alta Voce SAS	**Liuni**	**Marco**	Permanent (Chief Design Officer)	Scientific leader, partner 3 R&D in WP2 and WP3.1	12 p.month
Alta Voce SAS	**Degottex**	**Gilles**	Permanent (Chief Technology Officer)	R&D in WP2	6 p.month
Alta Voce SAS	**Berriot**	**Agate**	Permanent (DevOps)	R&D in WP2	3 p.month
Alta Voce SAS	**Trabelsi**	**Mohamed**	Permanent (Developer)	R&D in WP2	3 p.month
Comdata Group	**Premat**	**Vincent**	Permanent (Account manager)	Scientific leader, Partner 4 Coordination of operations for WP2,3 and 4	10 p.month
Comdata Group	Punctual participation by various staff (see Section II.b)		Permanent (Managers; Analysts; Operators)	Technical developments in WP2; research participants in WP3	18 p.month

AAPG2021	**ACCENT**		PRCE
Coordinated by:	Karim MIGNONAC, TSMR	Duration: 48months	Requested: 648k€
8.13. Industrie et usine du futur: Homme, organisation, technologies			

Changes made compared to the pre-proposal: No major change to the consortium or budget. Following comments in step1, we have clarified the (many) levels of collaboration between project partners and added one workpackage for project coordination. We have also described the concept of "augmented call-center" in more details (Figure 1) and clarified the different parameters that it will measure.

I. Proposal's context, positioning and objective(s)

a. Objectives and research hypothesis

There is a trend across all industries (ranging from online selling to telemedicine) towards the use of distant conversation systems and call-center-like operations for all organizational interactions, both internally (e.g. work meetings, employee HR services) and externally (e.g. B2B and B2C relations). The global health and economic crisis triggered by the COVID-19 pandemic, and the social distancing policies that ensued, have compelled many manufacturing and service organizations to switch part or all of their activities online (Mckinsey, 2020) and thus, amplified this trend. This ever-increasing reliance on distant voice-based operations (Groth et al., 2019) has potentially important, yet largely uncharted, implications for the performance of organizations and the well-being of their members.

This expansion of voice-based operations is accompanied by an unprecedented development of artificial-intelligence (AI)-based voice technologies (Huang & Rust, 2018), which creates attractive opportunities for voice synthesis (Oord et al. 2016) or real-time transformations of an employee's tone of voice, accent, sex or even language (Arias et al. 2020). Organizations are therefore faced with a situation where (1) an increasingly important part of their value is generated by distant, voice-based operations, (2) these occur in a technological landscape where potentially any conversational parameter can be optimized and personalized with voice technology, and yet (3) almost nothing is known about how these parameters impact the outcome of the conversation for employees and their organization.

ACCENT brings together an interdisciplinary group of researchers in management science, human & social sciences and engineering, as well as a major player in the customer-relation industry (Comdata) and an emerging voice-technology startup (Alta Voce) to build an 'augmented call-center', and use it as a laboratory to explore the human and organizational impact of voice technologies in the service industry.

In a first-of-its-kind initiative, the project will support the deployment in a real call-center of a novel voice technology able to transform the emotional tone of voice of employees and customers to make them sound, for instance, more smiling or more intelligible (Arias et al., 2020). We will, then, use this technological innovation to conduct high-volume, controlled experiments testing the impact of voice technology in both real and simulated calls on four outcomes (Figure 1): performance metrics (e.g., sales per hour, customer satisfaction); operator's well-being and emotional fatigue (Clark et al., 2019); usability, i.e. how voice transformations potentially transform the work activity, but also how the activity can also introduce changes in the technology (Latzko-Loth & Millerand, 2012); and acceptability, i.e. how morally acceptable the use of voice transformation is for the organization's stakeholders (agents, management, customers). Based on the outcomes of these experiments, we will design a control algorithm for the voice transformation system so that it adapts to the continuous measurements of these four parameters. For instance, the final system may trigger transformations on and off for certain types of employees (e.g. new, inexperienced hires), physiological states (e.g. tired at the end of the day), customers (e.g. angry frustrated customers) or ethical attitudes (e.g. only for employees in countries with an accepting attitude towards new technologies). Using a control system metaphor, our proposed "augmented call-center" therefore acts as a closed-loop control algorithm on the complex organizational system of a real-world call-center (Figure 1): in input, the augmented call-center gives control, via voice transformations, on the vocal parameters of each incoming and outgoing call; in output, it measures the impact of the modified voices on human and organizational factors. The flow measure of these parameters are continuously used to control voice transformations to make them adaptive to the dynamic reality in which the organization operates.

AAPG2021	ACCENT		PRCE
Coordinated by:	Karim MIGNONAC, TSMR	Duration: 48months	Requested: 648k€
8.13. Industrie et usine du futur: Homme, organisation, technologies			

In summary, ACCENT is a multi-disciplinary scientific project with a direct link to a concrete industrial matter. It adopts a process innovation that will affect the daily activities of the organization and, at the same time, provide flows of quantitative information on economic performances and the well-being of workers. The project aims to use such information to address key unanswered questions in how voice technologies affect organizations from an economic and human point of view, and to make a significant breakthrough in the design of the service systems of the future.

***Figure 1: The Augmented Call-center** is a closed-loop control algorithm on the complex organizational system of the real-world call-center: in input, it gives parametric control, via real-time voice transformations, on the vocal parameters of each call given and taken in the organization; in output, it measures the impact of these modified voices on human and organizational factors; and the continuous measure of these parameters are in turn used to control voice transformations to make their technological and organisational deployment adaptive to the ever-changing state of the organization.*

b. Position of the project as it relates to the state of the art

Impact of voice variables in service

The field of management science, notably, has a long history of studying factors that facilitate positive outcomes in voice-based operations (e.g. in our own previous work, Boujendar 2018), but does so by relying either on simulated environments or on observational studies. For instance, to study customer reactions to operators' emotional displays, researchers may design a simulated call-center in a university (e.g., Groth, Hennig-Thurau & Walsh, 2009) where fake operators are instructed to control their amount of smiling while they interact with other participants pretending to be customers. When studying real-world operations, researchers typically rely on cross-sectional studies, in which customer aggressiveness is correlated to employee's performance on the timescale of months (Sliter, Sliter & Jex, 2012). These simulated approaches have a limited capacity to explain real business situations, or, because they rely on correlations, do not provide direct insights regarding the impact of voice-associated variables.

Conversely, the field of cognitive science uses more direct interventional methods to investigate vocal communication, although it tends to focus chiefly on immediate perceptive judgements in a non-real-time context and in samples of participants (Boidron et al. 2016; Arias et al. 2020). For instance, Arias et al. (2020) manipulate recordings of 10 short spoken sentences with a transformation designed to simulate the 'sound of a smile', and finds that a group of 30 listeners judged these sentences as happier. However, the transfer of these results to real-business operations, where a massive number of employees and customers take decisions over the period of several hours or days, remains purely theoretical.

ACCENT's radical contribution consists in investigating the impact of voice transformations technologies at the size and complexity of a real-world situation. To do so, ACCENT will exploit a novel voice technology to directly manipulate the experience of customers and operators, in the partnership with one of the major players in the call-center industry. ACCENT will produce data on 100,000s calls and 100s of employees, thus contributing to the literature with unprecedented statistical power and organisational relevance.

AAPG2021	ACCENT		PRCE
Coordinated by:	Karim MIGNONAC, TSMR	Duration: 48months	Requested: 648k€
8.13. Industrie et usine du futur: Homme, organisation, technologies			

Social acceptability and ethics of voice technologies

An important aim of the project is to study the organizational impact of using voice transformations in a human system like the call-center. There is a substantial amount of work engaging with the social acceptability and ethics of new technologies (e.g. Bonnefon, Shariff & Rahwan 2020), but little has been done on the use of voice technologies, and expression transformation techniques (aka ``deep-fakes'') in general (Westerlund, 2019). One difficulty with the existing work is that it often occurs either too early (before the technology exists; Guerouaou, Vaiva & Aucouturier, in prep) or too late (after the technology has been deployed; Devillers et al. 2020). The former is often out of step with actual usage situations. For instance, the massive adoption in the 1990s of mood-enhancement drugs such as Prozac was initially faced with bioethical concerns about altering one's sense of authenticity and living truly (e.g., *"is it me or the Prozac enjoying this?"* - Schermer, 2015), until it was established that the general population's attitude to these drugs was, on the contrary, a feeling of empowerment (Kramer & Brody, 1994). To more directly observe the attitude of stakeholders towards innovations in a given time and culture, new experimental methodologies have proposed to crowdsource solutions to ethical dilemmas, presented as text vignettes (Awad et al. 2018). In recent years, this methodology has been applied to study factors underlying e.g. the moral acceptability of new technologies (Hidalgo et al., 2021), such as autonomous vehicles (Bonnefon, Shariff & Rahwan, 2016) or brain stimulation (Medaglia et al., 2019). However, these approaches are often limited by a lack of direct experience of the technology under scrutiny. Without access to the technology, researchers and participants can only design and take part in low fidelity experiments and do not confront moral dilemmas which have the most direct industrial and organisational implications.

Conversely, studying acceptability downstream, at the time of socio-technical controversies with an already deployed technology, is often too late. It often results in identifying that the technology's "usage scenario" (or "technological script" - Akrich, 2006) has been inaptly specified at the time of development, with no possibility to intervene in conception any longer (Nova, 2011). A much richer situation would be to intervene during the upstream phases of technological development and deployment, by observing modalities of appropriation of the device by potential users, to identify tensions and to propose recommendations (Rey, Simoncini & Triclot, 2021).

ACCENT departs from the state of art by studying user adoption and moral attitudes towards a technology, voice transformation, that we will first integrate in real-business operations. First, we will conduct inductive ethnographic survey and interviews with actors of the project (agents, managers and clients of the call-centers), to document how the technology potentially transforms the work activity, but also how the activity can introduce in return changes in the device, in a logic of "adoption" rather than simple "adaptation" (Stiegler, 2010). Second, we will conduct moral psychology experiments on the call-center stakeholders to study their attitudes towards moral dilemmas that have direct consequences for their professional lives. Doing so, we will not only identify what are the most socially acceptable ways to deploy voice technologies in the call-center organization, but we will also provide a case-study to build a method for incorporating ethical and sociological insights into organizational decision-making, legislation and public policy. Our perspective is that of "technical democracy" in the design work, beyond a simple perspective of social acceptability (Callon, Lascoume, Barthes, 2001).

Preliminary results

One important prerequisite for the project is the ability to incorporate real-time voice transformation in the telephony system used in the call-center, in a way that will allow the transformation of either the outgoing voice of operators when they talk to customers or the incoming voice of customers. The consortium has already conducted proof-of-concept tests showing that this was feasible: (1) a real-time algorithmic transformation of vocal smile already exists (a research outcome of previously-funded ANR project REFLETS – Arias et al. 2020), and has been patented and licensed by CNRS to partner Alta Voce; (2) a minimal version of the effect has already been tested in operations at partner Comdata. Preliminary results on (12 operators talking to customers either with the smile transformation or no transformation (A/B test) for 3

weeks - around 9,000 calls) on the sale of a large French audiovisual account, has shown that the smile transformation could lead to significant improvements of performance metrics, such as call completion rate in the 5-10% range. However, these preliminary tests also revealed important differences between operators and who they talk to, which go beyond gender, work experience or work site. These differences require more refined models to evaluate the true organizational impact of the technology and make it necessary to adapt the parameters of the voice transformations to the real-time state of the organization. These necessities motivate the present application.

c. Methodology and risk management

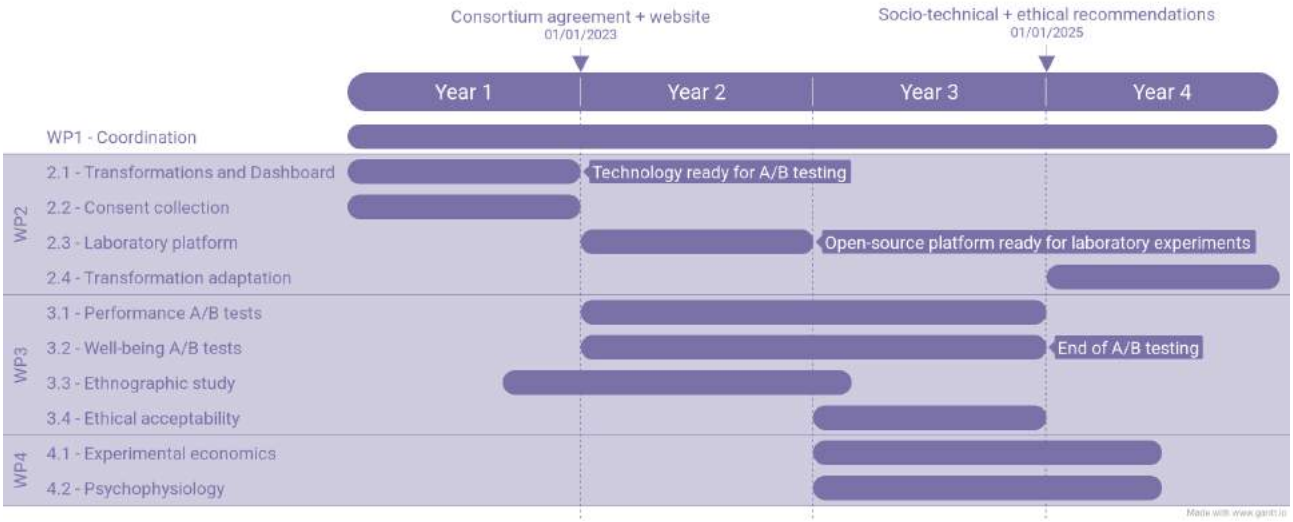

Figure 2: GANTT Diagram and relations between work packages: work in WP2 provides the technologies for the large-scale A/B testing of WP3 and the laboratory work of WP4. A/B testing in WP3 generates hypotheses for the laboratory work of WP4. Results from WP3 and WP4 provides rules and data for adapting transformations in WP2.4

WP1.Project coordination

Work in WP1, led by partner 1 (Toulouse School of Management Research - Management science team; technical lead: Karim Mignonac), is concerned with the project's scientific, administrative and financial management, as well as the promotion of its findings.

WP1.1 Scientific management

Objectives: Monitor the project's progress and facilitate collaboration between the partners
Work programme: Coordination will be ensured by periodic consortium meetings (twice a year), open to all project participants (including young researchers), during which activity reports (at M12, M24 and M36) will be presented and adopted.
Deliverables: D1.1. Activity reports (at M12, M24, M36 and M48)
Partner's contributions: Led by partner 1 (TSMR - Management science team). In addition, a nominated person ("technical lead") will monitor the progress of research activities in each WP.
Methods and technical decisions: Scientific management will be conducted by a steering committee chaired by the coordinator and composed of the technical lead of each WP. After consultation with all partners, it will take all major political, scientific and strategic decisions regarding the project, identify the emergence of risks and decide on fall-back solutions.
Risks and fall-back solutions: Risks for project coordination include difficulties due to multidisciplinary background of the academic participants (management science, economics, psychology, sociology and philosophy) and divergence of agendas between the project's academic and industrial partners. However, there are many reasons to believe that the research team can overcome these challenges. First, we break silos and combine partners of at least two partners and two disciplines for each task. Second, members of ACCENT hold (or have held) prominent leadership roles in interdisciplinary research centers. These roles

lead them to face interdisciplinary challenges and find integrated solutions. Moreover, members of the research team have, in their large majority, already worked together on interdisciplinary projects funded by large external grants and including partners; they have a strong record of collaborative research and have published in interdisciplinary journals. This will greatly facilitate the current project's coordination and success.

WP1.2. Administrative management and consortium agreement

Objectives: Draft the consortium agreement; implement a data management plan in order to ensure a better sharing and durability of project data and results; interface with the ANR project officer
Work programme: Drafting the consortium agreement will start at the beginning of the project with the objective of being finalized at T0+12. Data Management Plan (DMP) will be drafted at M6 and updated at M24 and M48.
Deliverables: D1.2. Implementation of the data management plan (M6,M24, M48); **D1.3:** Consortium agreement (M12)
Partner's contributions: Led by partner 1 (TSMR - Management science team); each WP technical lead will manage the administrative and financial tasks related to their WP. Administrative and financial elements will be discussed during consortium meetings.
Methods and technical decisions: The project's consortium agreement will use the model created for academic-industrial collaborations by ANRT (http://www.anrt.asso.fr/sites/default/files/unicanr-elucidation-mai-2010.pdf), and will explicitly address issues of IP shared between partners.
Risks and fall-back solutions: By using the ANRT template, risk is low for this task.

WP1.3. Financial management

Objectives: Monitor project budget in consortium meetings; write cost statements and financial reports
Work programme: Cost-statements issued with activity reports at the time of yearly consortium meetings.
Deliverables: D1.4. Cost-statement as part of activity reports (M12, M24, M36, M48)
Partner's contributions: Led by partner 1 (TSMR - Management science team); reports from each WP's technical lead.
Methods and technical decisions: Financial management will be ensured in a scrupulous way using the different financial management methods used within the partners, in accordance with ANR instructions. In case of issues, financial decisions will be discussed by the steering committee.
Risks and fall-back solutions: Risk is low on this task.

WP1.4 Promotion of the project and its results

Objectives: Implement actions that allow the project team to share knowledge, methods, tools and scientific progress produced during the project.
Work programme: Promotion actions will be discussed at each consortium meeting, and start at the beginning of the project.
Deliverables: D1.5. Project website (M12)
Partner's contributions: All partners will participate in the promotion of the project and its results.
Methods and technical decisions: Project's results will be published in general-science journals (e.g. from our previous work, PNAS 2016, 2018, 2020) as well as leading disciplinary journals in the field of management science (e.g. Journal of Management 2021, Journal of Organizational Behavior 2019), psychology (ex. Cognition 2017, 2021) or information systems (e.g. Communications of the ACM 2020). Beyond science, the project will engage with the societal, economic and cultural communities with a variety of actions, and notably target governmental agencies such as ANACT (working conditions) and CNPEN (ethics; see Section III - Impact & Benefits). Project's results will be disseminated via a project website, modeled on the website of TSMR's previous FAIRHEALTH project (https://fairhealth-anr.fr).
Risks and fall-back solutions: The risk is the lack of time to valorise project results. We alleviate this risk by discussing at each consortium meeting starting at M1

AAPG2021	ACCENT		PRCE
Coordinated by:	Karim MIGNONAC, TSMR	Duration: 48months	Requested: 648k€
8.13. Industrie et usine du futur: Homme, organisation, technologies			

WP2. Deployment and adaptation of voice transformations in a real and simulated call-centers

Work in WP2, led by partner 3 (AltaVoce; technical lead: Marco Liuni), consists, first, in incorporating real-time voice transformation in the telephony system used in the call-center to allow the field work of WP3, and in the experimental software for the laboratory work of WP4; and, second, to use the insights generated by WP3 and WP4 to create procedures to adapt the parameters of voice transformations to the real-time state of the call-center.

WP2.1. Deployment of fixed transformations in call-center and dashboard to control for A/B tests

Objectives: Facilitate the deployment of voice transformation modules in the real call-center environment; to provide a web-based dashboard for the easy creation and management of A/B tests for the purpose of WP3 experiments; to provide a technological framework to support the later adaptation work of WP2.4.

Work programme: The first step of the work is to deploy a limited set of fixed (i.e., non adaptive) voice transformations in the call-center environment, as well as a web-based dashboard with the ability to select whether the transformation is applied to the voice of the operator, of the customer, or both; to select groups of operators for a test; and to select days and randomization patterns during which transformations are alternated (e.g. one day smile, one day off). In initial experiments, operation outcomes (e.g. performance indices, well-being measures, etc.) will be collected outside of the system; later versions of the dashboard will include procedures to gather such data internally, and use them to adapt the parameters of the voice-transformation (WP2.4).

Deliverables: D2.1. User guide to install and implement A/B tests with voice transformations (M12)

Partner's contributions: Led by partner 3 (Alta Voce), in close interaction with the technical teams of partner 4 (Comdata).

Methods and technical decisions: Voice transformations: The project will use the two voice transformations currently made available by partner 3: intelligibility (which enhances acoustic features associated with speech comprehension - e.g. Kain & Van Santen 2009) and smile (which simulates the influence of smiling while speaking - Arias et al. 2020). The two transformations will be deployed in a client application, which can be installed remotely in batch on each of the call-center operator's machines (Figure 4). **A web-based dashboard** will allow to monitor the state of each application in the fleet (e.g. who's on and who's off, who's running what transformation, etc.), to remotely change their parameters (e.g. put 50% of the fleet off for a A/B test) and, in subsequent versions, to collect data about conversation outcomes (e.g. sales per hour, per agent and per day) from other sources within the project. While the normal operation of the application will be controlled remotely via the dashboard, a user interface (e.g. accessible via a task bar icon) will also allow the operators to manually activate the transformations if needed (a process which we will study in WP3.4).

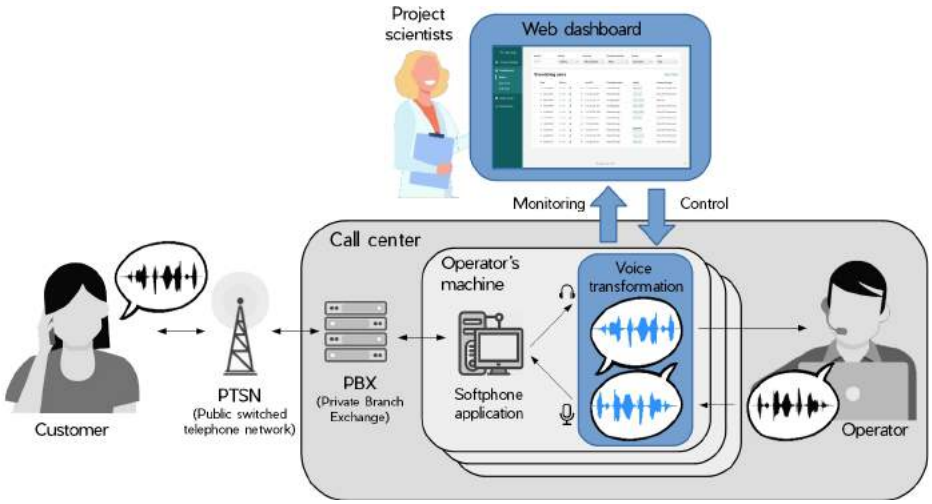

Figure 3: Integration of voice transformations in the call-center technical environment. *The application inserts itself as a virtual audio device visible to the software telephone software, and replace either the operator's microphone (to transform the outcalling operator's voice) or the operator's headphones (to transform the incalling customer's voice). All voice signal processing occurs locally in the application (i.e. not on the cloud), so that private conversation data is not streamed outside of the call-center. The only flow of information between the client application and Alta Voce's servers concern transformation parameters and the monitoring of their activity with a web dashboard.*

Risks and fall-back solutions: The feasibility of deployment is excellent: the methodology has been validated prior to the project by partner 4 (Comdata), and a minimal version of the system, incl. two voice transformation modules (smile and intelligibility) and a dashboard allowing the assignment of the transformations to users (Figure 4), is already deployed for tests in Comdata.

WP2.2. Procedure to gather informed consent from operators and customers, for WP3 experiments

Objectives: One major objective of the project is to enable the formal scientific study of voice transformations deployed in real call-center operations. However, prior experiments with massive data collection and interventions in web platforms such as Facebook (Kramer, Guillory & Hancock, 2014; Hallinan, Brubaker & Fiesler, 2020) have shown that it is essential before collecting such data to develop ethically-appropriate ways to collect participant's informed consent, especially in experiments involving outbound calls to real customers. The objective of WP2.2 is to develop a procedure to gather consent from the participants of WP3 experiments and to ensure data anonymization (Zimmer, 2010). Note that this task, which is concerned with experimental participants and research ethics (and is therefore mainly technical/operational) is different from task WP3.5, which is concerned with general public acceptability (and is empirical/scientific, for the purpose of eventual industrial deployment).

Work programme: The first part of the work will be to develop automatic consent forms for call-center operators (partner 4's employees) to take part in research; the second part will be to develop a procedure to gather consent from customers, in each individual call.

Deliverables: D2.2. User guide to install and implement consent forms in real call-center operations (M12)

Partner's contributions: Lead by partner 4 (Comdata), with contributions from partner 3 (Alta Voce) and partner 2 (FEMTO-ST - Cognitive science team).

Methods and technical decisions: Operators' consent will be collected using automated questionnaires (e.g. Quatrics) distributed via the call-center's telephony application. To avoid coercion and protect the rights and wellfare of employee participants (Resnick, 2016), supervisors will not directly recruit employee subordinates for research participation. Provisions in partner 4's project budget are made to compensate employee's lost bonuses for time spent participating in research. **Customers' consents** will be either collected via automated vocal messages prior to calls, or using follow-up SMS messages. **Data anonymization** outside of the call center will be guaranteed for operators by converting employee ids into non-identifiable MD5 codes, with a conversion key private to the call-center. No customer identifying information will be collected as part of the project. Notably, because of the technical choice of transforming voices locally (and not in the cloud, Figure 4), there will be no recording of conversations (where customer names may be pronounced).

Risks and fall-back solutions: The feasibility of collecting consent for operators is high. One risk concerns collecting consent for customers, which may be technically impractical in the current call-center telephony infrastructure and/or suffer from little acceptability (e.g. very little inclusion rate). One fall-back solution until this is solved is to focus on experiments which only collect data on operators (e.g. fatigue) and does not measure customer's behaviour (e.g. sales or satisfaction), and/or to focus on call-center campaigns for which customer acceptability is high (e.g. non-commercial support vs sales).

WP2.3. Integration of voice transformations into open-source video platform, for WP4 experiments

Objectives: Work in WP2.3 consists of using the voice transformation modules of partner Alta Voce to build an open-source tool able to do video calls between remote research participants, while their voice is being manipulated by real-time transformations. The tool will be used for the laboratory experiments of WP4.

Work programme: Work in WP2.3 is independent from WP2.1 and WP2.2; it reuses partner 3's core voice transformation libraries (SDK), but integrates them in a server-based application rather than in a heavy client as in WP2.1. Development in WP2.3 will be simultaneous to the experimental work of WP3, in order to allow the subsequent laboratory work of WP4.

Deliverables: D2.3. An open-source web-server application, to be used in WP4 and then distributed in the scientific community at the end of the project (M24).

Partner's contributions: WP2.3 is lead by partner 3 (Alta Voce), in interaction with partner 2 (FEMTO-ST - Cognitive Science team).

Methods and technical decisions : The tool will be developed as a WEBRTC server application, possibly in the Pion/Go implementation (https://github.com/pion/webrtc), in which the participants' audiovisual streams will be decoded on the server, and transformed with the Alta Voce voice transformation modules, integrated in the GStreamer interface (https://gstreamer.freedesktop.org/). The tool will be able to serve a video conferencing frame, for integration in the participants' web client. For WP4, the frames will be integrated in online psychology experiments programmed in existing web frameworks for online research, such as oTree (https://otree.readthedocs.io) or Gorilla (https://gorilla.sc). The tool will be released as open-source with a limited set of voice transformations (e.g., a pitch shifter, able to make participants' voices higher or lower); access to the Alta Voce transformations will be available to project partners via a research agreement, and to external parties subjected to licensing.

Risks and fall-back solutions: Developing a platform to run online experiments with voice transformation on remote participants is in itself a fall-back solution to the risk that the present covid situation makes the recruitment of in-lab participants difficult for the experiments of WP4. Beyond covid, the ability to run dyadic experiments remotely is highly innovative and useful for the field of social cognition. Feasibility for developing the platform is excellent, because voice transformation modules already exist, and partner Alta Voce has already run tests for integration in WebRTC. In case of delays, it will be possible to start the experiments of WP4 with non-remote participants (i.e. in the lab), using several machines communicating to one another with the client application of WP2.1., without waiting completion of WP2.3.

WP2.4. Procedures to adapt transformation parameters to the real-time state of the call-center

Objectives: To prototype a closed-loop "augmented call-center" architecture able to adapt voice transformation parameters to real-time measurements of human and organization factors.

Work programme: Control algorithms will be prototyped based on correlations data-mined in the large-scale experiments of WP3, and on causalities revealed by the laboratory experiments of WP4. The goal of WP2.4 is to reach TRL3-4 and put the prototype through functional and performance tests, but not in production. If successful, the prototype will be tested in pre-commercialization actions to be conducted after the project, for which the consortium will seek maturation funding such as BPI or EIC Pathfinder.

Deliverables: D2.4. Report on prototype implementation and functional tests (M12)

Partner's contributions: Led by partner 2 (Alta Voce), with contributions by all partners

Methods and technical decisions: The final system may trigger transformations on and off according to call context (e.g. *"only apply smiling for higher-end product sales campaigns"*), operator's state (e.g. *"only apply smiling to angry customers calling after 4pm"*), expertise and useability (e.g. *"only offer manual control for experienced employees"*) or ethical attitudes (e.g. *"only for employees in countries with an accepting attitude towards new technologies"*). The control algorithms will be either hand-designed (if clear categorical patterns emerge from data in WP3 and WP4) or, more likely, trained by machine learning (e.g. in the case of complex multivariate influence on e.g. performance). Algorithms will be tested on retrospective data from WP3.

Risks and fall-back solutions: Low risk. Even if no clear patterns emerge from WP3 and WP4, the control of voice transformation algorithms can still be optimized agnostically with machine learning.

WP3. Controlled A/B experiments in real-life call center operations

Work in WP3, led by partner 1 (TSMR - Management Science team), consists of using the technical development of WP2 to conduct controlled A/B experiments which tests the impact of voice technologies over 100s of operators in real-life call-center operations, on measures of performance (3.1) and well-being (3.2) as well as surveys of social (3.3) and ethical (3.4) acceptability.

WP3.1. Impact on performance indicators (sales and customer satisfaction)

Objectives: The aim of WP3.1 is to conduct large-scale A/B experiments to disentangle the specific contribution of voice technologies on operators' performance, asking questions such as « *Does the use of smile transformation correlate with increased sales-per-hour ?* ».

Work programme: WP3.1 will use the technological development of WP2.1 to deploy voice transformations in real call-centers operations and control their operations to conduct A/B tests, and uses the consent tools of WP2.2 to collect performance data from calls performed with and without voice transformations. Findings in WP3.1 will generate hypotheses for laboratory experiments in WP4.

Deliverables: D3.1 Report on micro-economic analyses (M36)

Partner's contributions: Lead by partner 1 (TSMR - Management Science team), with contributions from partner 2 (FEMTO-ST - Sociology team) and partner 3 (Alta Voce), and involving personnel at partner 4. .

Methods and technical decisions: Data collection: Voice transformations will be assigned to call-center agents on a daily basis, with random rotations among possible transformations (e.g. one day, intelligibility; one day, smile; one day, no transformation). We will conduct at least 4 data collection campaigns, including typically N=50 agents, followed longitudinally for 8 weeks, resulting in 10,000s hours of real-business operations. Participating operators and customers will be blind to which transformation is active at any given time. Performance indicators (KPI) will be measured at the level of individual calls (e.g. monetary value if the transactions, customer satisfaction) or aggregated over a day (e.g. sales per hour). **Analysis:** Data will be analysed with multilevel statistical models, incorporating several control variables such as the type of sale, circadian variations (time of day, what day in week, what week during the sales campaign), as well as idiosyncratic characteristics of agents (e.g. organizational abilities - Herjanto and Franklin, 2019; voice characteristics such as vocal pitch - Ponsot et al. 2018) and consumers (e.g. wealth). In coordination with WP3.2 (below), subsequent analyses will also incorporate employee burnout/fatigue rate (e.g. subtracting the start-of-work time to the call time to measure fatigue in a day) and frustration (e.g. number of hours passed without selling any contracts) as control variables.

Risks and fall-back solutions: The feasibility of data collection, which has already been tested by the consortium members (Figure 2), is excellent. Data analysis is also low-risk, because it is easy to incorporate alternative measurements in models if planned variables are not available, and because it is easy to collect additional data in new experiments if more complex models are needed.

Ethics: Enabling the collection of such unique data in full accordance with research ethics is one of the most important objectives for the project (and the rationale to include academic partners in the AltaVoce-Comdata relation in the first place - Hallinan, Brubaker & Fiesler, 2020). All participants (agents and customers) will give informed consent for participating (see WP2.2). No identifying data (incl. no speech recording) will be collected. All experiments will be subjected to the prior clearance of the Toulouse University Internal Review Board (IRB).

WP3.2. Impact on employee well being

Objectives: The purpose of this task is to examine whether voice transformations (e.g. smile) of call-center agents and customers can improve the daily well-being of agents, via their effects on customer (positive and negative) attitudes, asking questions such as "*Does customer smiliness correlate with less employee fatigue at the end of the day*".

Work programme: As mentioned earlier, WP3.2 will use the technological development of WP2.1 to deploy voice transformations in real call-centers operations. Well-being will be assessed via surveys and physiological measurements during a 3-week field visit in the call-center. Because the influence of staff's mood on customers' behavior is well-documented (Furnham and Milner, 2013), findings from WP3.2 will also be used to quantify employee fatigue / well-being in subsequent analyses of WP3.1, and generate hypotheses for laboratory experiments in WP4.

Deliverables: D3.2. Report on the impact of work on well-being (M36)

AAPG2021	ACCENT		PRCE
Coordinated by:	Karim MIGNONAC, TSMR	Duration: 48months	Requested: 648k€
8.13. Industrie et usine du futur: Homme, organisation, technologies			

Partner's contributions: Lead by partner 1 (TSMR - Management Science team), with contributions from partner 2 (FEMTO-ST - Cognitive Science team), and the involvement of personnel at partner 4 (Comdata).
Methods and technical decisions: Data collection: Following previous research (Song et al., 2018; Boujendar, 2018), we will conduct a within-person field experiment utilizing a daily experience sampling approach with 100 employees. Employees will be surveyed for their feeling of work engagement, emotional exhaustion and mood during 3 consecutive weeks (i.e., 15 work days, randomly assigned with and without voice transformation). In addition, during the same visit, we will conduct longitudinal physiological measurements on a subset of the participants (N=20) using connected watches measuring skin conductance and heart rate. **Data analysis:** The impact of voice transformations on well-being survey data will be analysed using the methodology developed in Boujendar (2018). Physiological data will be analysed to derive the participant's skin conductance tonic level (SCL) and heart-rate variability for each call (Massaro & Pecchia, 2019), and correlated with employee fatigue in the day and the acoustic and economic characteristics of each call (Rohrmann et al., 2011).
Risks and fall-back solutions: Similarly to WP3.1, feasibility for this task has already been tested and is excellent. Possible risks include difficulty to include a sufficient number of agents because of the perceived cost of answering surveys (reduced performance, bonus) or reluctance to engage with physiological measurements. We will alleviate these risks by provisioning budget for partner 4 (Comdata) to compensate employees for lost business hours, and by conducting a feasibility study of participant acceptance of the connected watch (e.g., Chabin et al., 2020). Fall-back solutions include laboratory simulations of the same tasks as part of WP4.
Ethics: As for WP3.1, all participants will give informed consent, data will be stored anonymously, and experiments subjected to prior clearance by an IRB.

WP3.3. Ethnography of usability

Objectives: The aim of WP3.3 is to conduct a situational observation of the deployment of the voice transformation among call-center employees, using the methodology of ethnography, to document the modalities of appropriation of the technology by its users, identify tensions and propose recommendations; asking questions such as "*If given the choice, when do operators decide to turn on the voice transformation*".
Work programme: WP3.3 will use the technology developed in WP2.1, in a different mode of functioning than for the A/B tests of WP3.1 and WP3.2 (where voice transformations are automatically turned on and off), by letting employees freely interact with the voice transformations. To avoid side effects from the previous studies, the field study of WP3.3 will occur on a different worksite than that of WP3.1 and WP3.2, and take place before, during and after the deployment of the technology (18m).
Deliverables: D3.3. Socio-technical recommendations for the deployment of voice transformations in call centers (M36)
Partner's contributions: Lead by FEMTO-ST (Sociology team), in collaboration with user experience designers at partner 3 (Alta Voce), and with the involvement of personnel at partner 4 (Comdata).
Methods and technical decisions: We will conduct inductive ethnographic surveys and interviews with actors of the project (employees and managers of the concerned call centers, but also participants of the research project, researchers and engineers), focussing on the "constitutive" dimension of the technology (Triclot, 2013; Verbeek, 2011): how it potentially transforms the work activity, but also how the activity can introduce in return changes in the device, in a logic of "appropriation"/"hybridization" inspired by the sociology of use (Sociologie des usages; Pizelle et al. , 2014; Von Hippel, 2006). The recent interventions of the FEMTO-ST Sociology team in several technological innovation projects (Rey, Simoncini & Triclot, 2021) have confirmed the interest for human and social sciences to intervene during the upstream phases of technological development and deployment. The interest of such fieldwork is to reopen and enrich the "technological scripts" (Akrich, 2006) and "uses scenarios" initially planned, which regularly prove to be out of step with actual usage situations (Nova, 2011). This reopening will notably examine the consequences of giving the user control over the filter provided by the device, in a form that applies to his or her own voice

(digital make-up) or to that of the interlocutor (digital protection). It could also reveal different modes of control over the filters (intensity, type of effects) and variations in appropriation according to the type of call (e.g., sales or customer relations), social characteristics (age, gender, social origin, etc), professional experience or work situation (in a call center, telecommuting or freelance).

Ethics: As for other WP3 tasks, all participants will give informed consent, and data will be stored anonymously.

WP3.4. Moral acceptability

Objectives: Work in WP3.4 consists of collecting experimental data on the perceived moral acceptability of using voice transformation in relation to the various purposes, contexts and technologies involved in the augmented call center and elaborated in WP2; asking questions such as *"Do customers find acceptable that their own voices are transformed without their knowing"*.

Work programme: Studies will be conducted online, among call-center stakeholders, and vignettes will be designed to match the exact combinations of situations and parameters tested in the other WP3 tasks.

Deliverables: D3.4. Ethical recommendations for the deployment of voice transformations in call centers (M36).

Partner's contributions : Lead by partner 1 (TSMR - Ethics team), with contributions from partner 2 (FEMTO-ST, Sociology/Philosophy/Economy team)

Methods and technical decisions: We will use the methodology of experimental moral psychology (Bonnefon et al., 2016; Guerouaou, Vaiva & Aucouturier, in prep), in which participants judge the moral acceptability of situations involving voice transformations in call-center operations, described with vignettes designed to match the exact combinations of situations and parameters measured in other WP3 tasks. The participants will be call-center stakeholders (e.g., employees) and representative samples of the general population. The vignettes will be developed with a graphical designer to improve their clarity, and will be illustrated with real conversation examples and audio examples of voice transformations extracted from other WP3 tasks. Additional attention will be given to vignettes exploring tradeoffs between organizational benefits and transparency, as well as vignettes exploring ethical conflicts (e.g., using accent-removal technology may increase workplace inclusion, but at the cost of normalizing prejudice).

Risks and fall-back solutions: There are no risks associated to WP3.4, given the ample experience the partners had with similar tasks in the past.

Ethics: As for other WP3 tasks, all participants will give informed consent, data will be stored anonymously, and experiments subjected to prior clearance by an IRB.

WP4. Laboratory experiments in simulated call environments

Work in WP4, lead by partner 2 (FEMTO-ST), consists of using the open-source video call tool built in WP2.3 to conduct laboratory experiments in which remote participants interact with one another while their voice is being manipulated by transformations. These experiments extend the semi-experimental studies of WP3, allowing to test specific effects of voice parameters on economic behaviour and decision-making (WP4.1), as well as emotions and well-being (WP4.2).

WP4.1. Experimental economics experiments of performance outcomes

Objectives: Conduct experimental economics studies testing the influence of voice parameters on economic behaviour and decision making, addressing questions such as *« Does smiling causally influence perceived product value? »*

Work programme: Experiments in WP4.1 will test hypotheses generated by the correlational findings of WP3.1. They will be conducted on samples of the general population (e.g., students from Université de Bourgogne-Franche-Comté, associated third-party to partner 2).

Deliverables: D4.1. Scientific papers (M48)

Partner's contributions: Lead by partner 2 (FEMTO-ST - Cognitive science team), with contributions from partner 1 (TSMR - Ethics team)

Methods and technical decisions: We will construct laboratory situations which simulate call-center interactions (video calls) between two participants acting as operators or customers, and measure the economic value (e.g. willingness to pay, customer satisfaction) that potential customers attribute to a product with and without the use of voice transformation. WP3 effects on customer and employee mood will be tested by controlling the mood of the participants using real-world emotions (Attanasi et al., 2019), by running experiments on the day the student population of the university receives test scores for the semester, distinguishing between students who better and worse than predicted scores (Villano et al. 2020). We will also test for the impact of voice characteristics data-mined from WP3 data (e.g. vocal pitch) on economic decisions, by manipulating these characteristics with additional voice transformations in the lab (Rachman et al. 2018) and/or conducting acoustical analyses on the participants' voices.

Risks and fall-back solutions: Risks associated with T4.1. mainly include delays or difficulties involved with the development of the open-source tool of T2.3. Fall-back solutions include designing in-lab (non-remote) experiments with two participants using the client application of T2.1, or with a single participant interaction with a simulated interlocutor (as in our previous work, Boidron et al. 2016).

Ethics: All participants will give informed consent, data will be stored anonymously, and experiments subjected to prior clearance by an IRB.

WP4.2. Psychophysiology experiments of well-being outcomes

Objectives: Conduct psychophysiology experiments testing the influence of voice parameters on participant's physiology and well-being, addressing questions such as *« Does smiliness causally influence listener's heart rate variability? »*

Work programme: Experiments in WP4.2 will test hypotheses generated by the correlational findings of WP3.2, notably from physiological variables observed as associated with voice A/B testing. They will be conducted on samples of the general population (e.g., students from Université de Bourgogne-Franche-Comté, associated third-party to partner 2).

Deliverables: D4.2. Scientific papers (M48)

Partner's contributions: Lead by partner 2 (FEMTO-ST - Cognitive science team), with contributions from partner 1 (TSMR - Management science team)

Methods and technical decisions: Similarly to WP4.2, we will construct laboratory situations in which participants will take part in dyadic conversations while we manipulate their voice with real-time transformations without their knowing. We will test the impact of smile transformations in conversations on e.g. participant mood measured remotely with facial expression analysis (Arias et al. 2020) and video photoplethysmography (Li et al. 2020), or in the lab with facial electromyography. We will test the impact of voice intelligibility on participant's fatigue and cognitive load remotely using pupil dilation, or in the lab using electroencephalographic measures (Miles et al. 2017). Additional attention will be put to measures of emotion contagion within conversation partners (e.g. facial mimicry, inter-brain synchrony) and how these may moderate joint decision-making variables measured in WP4.1. (Reinero, Dikker & Van Bavel, 2021).

Risks and fall-back solutions: Similar to WP4.1.

Ethics: As in WP4.1, all participants will give informed consent, data will be stored anonymously, and experiments subjected to prior clearance by an IRB.

A final note on the impact of the covid situation: We have designed the project to be largely resilient to possible periods of containment or distancing. Development work of WP2 can be entirely done remotely. Operations at Comdata, as in the global call-center industry, have now largely pivoted to remote working and we have confirmed that voice-transformation software can be deployed in the operators home, making WP3 equally feasible. Finally, because covid can hinder the recruitment of participants in the lab, we have designed WP4 to use a new open-source tool enabling to work remote participants. In fact, because remote operations are now so common, the covid situations make our project ever more relevant.

AAPG2021	ACCENT		PRCE
Coordinated by:	Karim MIGNONAC, TSMR	Duration: 48months	Requested: 648k€
8.13. Industrie et usine du futur: Homme, organisation, technologies			

II. Organisation and implementation of the project

a. Scientific coordinator and consortium

The two academic partners involve two large, well-recognized CNRS units with complementary expertise in management science and ethics (TSM Research in Toulouse, UMR5303 CNRS/Univ. Toulouse 1 Capitole), and engineering and social science (FEMTO-ST Institute in Besançon and Belfort, UMR6174, CNRS/Univ. Bourgogne Franche Comté). The two industrial partners bring additional, complementary expertise that are essential to the project, with technological skills in real-time voice transformation (ALTA VOCE, an emerging voice-tech startup) and a strong potential of application to real-world operations (COMDATA Group, a major player of the French call-center industry). It has to be noted that the two industrial partners already have a working relation, which makes the project highly feasible.

Scientific coordinator. Karim Mignonac is full professor of Organizational Behavior at Univ. Toulouse 1 Capitole and the director of Toulouse School of Management Research (TSMR). He is also a member of the scientific committee of Pole Emploi. His research interests are well in line with the project and include workplace commitment and well-being. His work has been published in well-regarded academic journals incl. Strategic Management Journal, Journal of Management and Journal of Organizational Behavior. K.M. is highly experienced in research team management and has been involved in the coordination of several research projects, incl. ANRs FAIRHEALTH (2018–22), FRANBLE (2012–16) and FRANMIX (2008–11). He is not currently involved in the coordination of any ANR project besides the current proposal and will devote 50% of his time (24 person.month) to ACCENT.

Partner 1 (TSM Research) in Toulouse (UMR5303, CNRS, Univ. Toulouse 1 Capitole) is one of the 3 French laboratories in management accredited by the CNRS (along with HEC, and Paris Dauphine University). TSMR's research spans all fields of management science, incl. marketing, accounting, finance, strategy and Human resources and Organizational Behavior. Management Science Team**:** Prof. Karim Mignonac and **Dr. Sarah Boujendar** (MCF in Human Resources, *Prix de thèse Association Francophone de Gestion des Ressources Humaines, 2019*) will supervise TSM's involvement in WP3, bringing expertise in the study of organizational behaviour, and vocal aggressiveness in call-center operations. Ethics Team**: Dr. Jean-François Bonnefon** (Directeur de recherche CNRS, *Médaille de bronze CNRS 2008*) will supervise TSM's involvement in WP3.4, bringing expertise in social sciences and behavioral ethics, as well as experience leading a well-known international research program in the ethics of autonomous vehicles which led to publications in Science (2016), Nature (2019) and PNAS (2020).

Partner 2 (FEMTO-ST Institute) in Besançon and Belfort (UMR6174, Université de Franche–Comté, CNRS, ENSMM, UTBM) is one of the country's largest engineering and system science research unit, with a research program spanning manufacturing systems, industry 4.0 and the sociology/philosophy of technological innovation.Cognitive Science Team: **Dr. Jean-Julien Aucouturier** (Directeur de recherche CNRS, *Prix Emergence Scientifique de la Fondation pour l'Audition 2018*) will supervise FEMTO-ST's involvement in the project. JJA brings expertise in voice psychology, access to a neurophysiology laboratory for the experiments of WP4, as well as experience running a successful ERC-funded research program (2014-2019) which led to publications in PNAS (2016,2018), Current Biology (2018) and Nature Communications (2021). Sociology and Philosophy Team: **Dr Benedicte Rey** (MCF in Sociology) will coordinate FEMTO-ST's involvement in the ethnographic study of WP3.3, in collaboration with Dr Mathieu Triclot (MCF in Philosophy), Dr Nicolas Simoncini (MCF in Sociology) and Dr Ylenia Curci (MCF in Economics), also involved in WP3.1.

AAPG2021	ACCENT		PRCE
Coordinated by:	Karim MIGNONAC, TSMR	Duration: 48months	Requested: 648k€
8.13. Industrie et usine du futur: Homme, organisation, technologies			

Partner 3 (Alta Voce) in Paris (http://alta-voce.tech) is an emerging voice-tech startup specializing in real-time emotional voice transformations for the customer relation and entertainment industries, originated in computer music institute IRCAM in Paris, and supported by the CNRS Innovation program and BPI French Tech funding. **Dr. Marco Liuni** (Chief Design Officer) will supervise Alta Voce's involvement in WP2, in collaboration with Dr. Gilles Degottex (CTO), Agate Berriot (DevOps) and Mohamed Trabelsi (Windows developer), bringing expertise in real-time voice transformations, web service development, and prior experience working with partner Comdata to deploy technologies in the call-center environment.

Partner 4 (Comdata Group France) in Gennevilliers (https://france.comdatagroup.com). The Comdata Group is a leading global service provider in customer Interaction, employing more than 50,000 employees and operating more than 100 call-centers in 22 countries. Comdata France is the country's third biggest operator. **Vincent Premat** (Account manager) will supervise Comdata's involvement in the project, bringing expertise in call-center operations and innovation, and prior experience working with partner Alta Voce.

Implication of the scientific coordinator and partner's scientific leader in on-going project(s)

Name of the researcher	Person.month	Call, funding agency, grant allocated	Project's title	Name of the scientific coordinator	Start - End
Karim Mignonac (partner1)	12	ANR PRC	FAIRHEALTH	Caroline Manville (TSMR)	2018–2022
Jean-Julien Aucouturier (partner 2)	15	ANR PRCE	REFLET	Catherine Soladié (CentraleSupelec)	Sept. 2017-Aug. 2021
	15	ANR PRC	SEPIA	Marie Gomot (iBrain, Tours)	March 2020-Feb. 2024
	4	ERC Proof of Concept	ACTIVATE	JJA	Sept. 2020-March 2022

b. Implemented and requested resources to reach the objective

The global budget requested is 669k€ divided among the four project partners.

Partner 1: TSMR (237k€) Staff expenses: The project will fund one postdoctoral fellow for 24m., working on the real-world experiments of WP3.1 and WP3.2; hired by Université Toulouse 1 Capitole (99,600€); co-supervised by KM and SB. Background: Management science; as well as one postdoctoral fellow for 12m., working on the ethics experiments of WP3.4; hired by Université Toulouse 1 Capitole (49,800€); supervised by JFB. Background: Psychology.Total: 149,400€. Instruments and material costs: Equipment for the project includes laptop computers for the two postdoctoral fellows and the coordinator (3x 2,000€).Total:6000 €. Outsourcing / subcontracting: Expenses for database, software licenses for statistical analysis (2X 1500€; 3000 €), publications fees (copy editing and publication costs; 8000€), website and videos (5000€), and gifts for participants (7500€). General and administrative costs & other operating expenses: Travel for the project includes coordination meetings between Toulouse, Besançon and Paris, annually (250€ x 5 pers. x 4 years; 5,000€); Travel for 4 field visits in Comdata, for the studies of WP3.2 (2 people x 2,000€ per visit x 4 visits; 16000 €), as well as travel for 4 international conferences such as International Ergonomics Association, Academy of Management or Society for Industrial and Organizational Psychology (1500€ x 2 people x 4 meetings; 12,000€). Total:33,000 €

Partner 2: FEMTO (242k€) Staff expenses: The project will fund one postdoctoral fellow for 18m., working on the laboratory experiments of WP4.1 and WP4.2; hired by CNRS (82,277€); co-supervised by JJA and YC; Background: experimental economics/cognitive science; as well as one postdoctoral fellow for 18m., working on the ethnography field study of WP3.3; hired by CNRS (82,277€); co-supervised by BR and

MT. Background: sociology/philosophy. Total: 164,554.76€. Instruments and material costs: Equipment for the project includes laptop computers for the two postdoctoral fellows and member YC (3x 2,000€; total: 6,000€); connected watches for the physiology measurements of WP3.2 and WP4.2 (Empatica E4: 1,690€ x 10 units; total: 16,900€); research-grade audio headphones (ex. Beyerdynamics DT770; 2x200€) and sound cards (RME Fireface, 2x1,000€); one software license for large-dataset statistical software (STATA: 2,500€). Total: 27,800€. Outsourcing / subcontracting: n/a. General and administrative costs & other operating expenses: Travel for the project includes coordination meetings between Toulouse, Besançon and Paris (250€ x 4 pers. x 4 years; 4,000€) and the two FEMTO-ST sites in Belfort and Besançon (30€ x 2 pers. x 15; 900€); travel and accommodation for 4 field studies in Comdata for WP3.3 (2 people x 1,000€ per visit x 4 studies; 8,000€). In addition, the project will support open access manuscript charges at e.g. Nature Human Behaviour, PNAS, and other suitable journals (Total cost: 4x 2,500€, 10,000€) and participant fees for the healthy participant studies of WP4 (10€/hr; 100 participants x1.5hr; total 1,500€). Total:24,400 €

Partner 3: ALTA VOCE (105k€) Staff expenses: The project will fund the involvement of permanent staff Marco Liuni (Chief Design Officer), working on project coordination and user experience design for WP2.1 and WP2.4 (12m; total: 96,000€); Gilles Degottex (CTO), working on algorithmic design for WP2.1 and WP2.4 (6m; total: 48,000€); Agate Berriot (DevOps), working on web-service development for WP2.1 and WP2.3 (3m; total: 24,000€) and Mohamed Trabelsi (Developer), working on development for WP2.1 (3m; total: 24,000€). Total: 192,000€ (45% funding).Instruments and material costs: Equipment for the project includes laptop computers for all project members (4x 2,000€; total: 8,000€). Outsourcing / subcontracting: n/a. General and administrative costs & other operating expenses: Travel for the project includes coordination meetings between Toulouse, Besançon and Paris (250€ x 2 pers. x 4 years; 2,000€); travel for 4 site visits in Comdata (2 people x 250€ per visit x 4; 2,000€). In addition, the project will fund server costs for the deployment of 250 applications in WP3 (1,000€). Total: 5,000€

Partner 4: COMDATA (62k€) Staff expenses: The project will fund, at cost price, the involvement of permanent Comdata staff over and beyond their normal duties to make possible project research. This includes project management in WP1 (1 IT manager for 30d x 500€; 15,000€); data and network access for WP2.1 (R&D Analyst for specification: 1.5d x 500€; web-service developer for data access: 6d x 350€; network administrator for security and network port access: 3d x 500€; total: 4,350€); the development of consentment collection in WP2.2 (HR manager for analysis and presentation to employees: 6d x 650€; telephone service developer for implementation of vocal message: 3d x 500€; quality assurance manager for wording of message: 3d x 500€; jurist for impact study and legal risks: 3d x 500€; account manager for the selection of appropriate B2B client and campaign, client presentation and obtaining client approval: 6d x 650€; Total: 12,300€); compensating for call-center operator non-productive time while answering surveys and interview for WP3.2 and WP3.4 (operators: 1050hr x 25€; managers: 30d x 200€; total: 32,250€); and compensating possible loss of performance due to negative effect of voice transformations (est. 15hr loss of performance x 25€ x 200 operators; total 75,000€). The cumulated involvement of Comdata staff is estimated at 18p.m, with an additional 10p.m by partner technical lead Vincent Premat for coordination (not funded). Total: 138,900€ (30% funded). Instruments and material costs: n/a. Outsourcing/subcontracting: The project will support the subcontracting to an external legal consultancy of an impact study of the legal risks involved with deploying voice transformation on call-centers employees and customers. Parts of the study will be used to draft the ethical and socio-technical recommendations of WP3.3 and WP3.4 (20hr x 500€; 10,000€).Total: 10,000€. General and administrative costs & other operating expenses: Travel for the project includes coordination meetings between Toulouse, Besançon and Paris, annually (300€ x 1 pers. x 4 years; 1,200€); 8 visits at Comdata work sites for coordination of the studies of WP2 (300€ x 1 pers. x 8 visits; 2,400€); two presentations of the project (incl. travel, speaker fees, stands) at professional customer relation conventions (6,000€ x 2 presentations; 12,000€). Total: 15,600€.

AAPG2021	ACCENT		PRCE
Coordinated by:	Karim MIGNONAC, TSMR	Duration: 48months	Requested: 648k€
8.13. Industrie et usine du futur: Homme, organisation, technologies			

Requested means by item of expenditure and by partner

		Partner 1 TSMR (Université Toulouse 1 Capitole)	Partner 2 FEMTO-ST (CNRS)	Partner 3 Alta Voce	Partner 4 Comdata Group France
Staff expenses - New recruitment with funding requested		**149 400,00**	**164 554,76**	**0**	**0**
Staff expenses - Permanent with funding requested				**192 000,00**	**138 900,00**
Instruments and material costs (including the scientific consumables)		**6 000,00**	**27 800,00**	**8 000,00**	
Building and ground costs		**0**	**0**	**0**	**0**
Outsourcing / subcontracting		**23500,00**	**0**	**0**	**10 000,00**
General and administrative costs & other operating expenses	Travel costs	**33000,00**	**24 400,00**	**5 000,00**	**15 600,00**
	Administrative management & structure costs	**25,428.00**	**26 010,57**	**29 450,00**	**43 462,00**
Sub-total		**237 328,00 (100%)**	**242 765,33 (100%)**	**234 450,00 (45%)**	**207 962,00 (30%)**
Total cost		**922 505,33**			
Requested funding		**647 984,43**			

III. Impact and benefits of the project

a. Fields of impact

Scientific - Management science: our project will radically advance what we know of the impact of voice on employee well-being and employee productivity in the service industries, a topic which can only grow in prominence in the current socio-economic context. In addition, by pioneering the use of voice transformation technologies to study this question, the project will create a profound paradigm shift away from correlational or simulation studies and start a new strand of methodological paradigms that use expressive technologies (e.g., deep-fakes) to study real-world operations over and beyond call-centers (e.g. tele-medecine, remote job interview, remote justice, etc.). **Cognitive science:** the project will develop a ground-breaking new software platform (WP2.3) to conduct interactive experiments on remote participants while being able to control their voice parameters in real-time, and disseminate this tool in the scientific community as open-source software (modelled after our successful DAVID toolbox (https://forum.ircam.fr/projects/david/details, 4000 downloads since March 2018). Using the platform, project members will crack important new problems on the impact of conversational emotions in decision-making and listener's physiology; beyond our consortium, we anticipate that the platform will also be used for a wide variety of social-cognitive questions (e.g. teacher-student interactions, group decision-making, creativity, etc.). **Ethics and sociology:** the project will be first to directly address the emerging question of the social acceptability of vocal or facial deep-fakes. Because of the imminent social adoption and massive economic market of deep-fakes (e.g. the anticipated release of Apple's AR device Apple Glasses), this research program is

expected to have at least as much impact as our previous work on autonomous vehicles (Bonnefon et al., Science 2016, Nature 2019, PNAS 2020).

Economic: Beyond science, the potential economic impact of our project is very important. The global customer relation market is worth $340 Billions in 2020, growing at 5% yearly. Within this market, real-time voice transformations address the segment of voice-based software technologies, which alone is worth $19 Billions. Our preliminary results deploying voice transformations in real call-center operations have suggested that the technology improves performance indices such as sales per hour by an average 5-10%. Through controlled experiments and subsequent optimizations, the project should confirm and improve these numbers. This suggests that, upon completion, project ACCENT will create the opportunity of a +10% increase of revenue for the call-center industry. Projected to Comdata France, our impact could scale up to a €30 million increase in revenue; projected to the global market, this is an increase of $1.9 Billion.

Societal: The global call-center industry employs more than 23 million workers, in what is often perceived as "white collar sweatshops" where employees are poorly paid and work under stressful conditions. Call-center workers have turnover rates between 30-45%, more than double the average for other occupations, and are absent 8.2 days per year**,** which is 0.8 day higher than other industries (Doellgast & O'Brady, 2020)**.** By generating novel managerial insights on how voice parameters impact workers physical and emotional fatigue, project ACCENT will improve employee well-being. In addition, by issuing socio-technical recommendations on the best deployment of voice technologies, our project will help organizations focus on their capacity to augment rather than merely replace employees. Perhaps even more importantly, because we will conduct our research in the upstream phases of technological development and involve real call-center employees and customers, our work will also build a method for incorporating ethical and sociological insights into organizational decision-making, legislation and public policy. The project's legacy will be nothing short of fulfilling the promise of a "technical democracy" (Callon, Lascoume, Barthes, 2001), the enrichment of traditional representative democracy with new procedures for consultation and representation involving both experts and non-experts, ordinary citizens and politicians.

b. Initiatives covering relations between science and society

Project members are already highly active in relations between science and society, with participations in general public science events (e.g. Pint of Science, UNESCO Semaine du son, etc.), science communication (e.g. https://lejournal.cnrs.fr/videos/dis-moi-bonjour-et-je-te-dirai-qui-tu-es), media relations (e.g. https://www.tf1.fr/tmc/quotidien-avec-yann-barthes/videos/invite-jean-francois-bonnefon-interroge-morale.html) and business communication (https://www.alternatives-economiques.fr/communiquer-rse-cout-de-tartuferie/00081841).

Beyond these actions which we will continue to deploy in relation to the project, project ACCENT will fund two specific initiatives aiming to directly engage with society. First, although there are policy-makers using academic outputs as a source of information, scientific publications are not necessarily the first choice as dissemination material to be used within decision-making processes. For this reason, the project will develop specialized tools (i.e., assessment tools, risk management procedures, intervention protocols and pedagogical kits) aimed at improving and promoting voice technologies in the workplace. Project members have already contributed to developing and implementing such tools (e.g. https://www.moralmachine.net) and are able to capitalize on previous work. All these materials will be made freely available via the outreach platform of our partner institution Toulouse School of Management.

Second, we will target our dissemination on two important governmental agencies/boards concerned with working conditions (French National Agency for the Improvement of Working Conditions - ANACT) and ethics in digital innovation (Comité National Pilote de l'Ethique du Numérique, CNPEN). Both agencies are highly active in the design and implementation of public incentive policies, and are tasked to organize public consultations in the upstream phase of drafting law reform. Informal contacts have already been

made with both committees, e.g. with the objective of participating in ANACT's webinar series or "Semaine pour la qualité de vie au travail".

c. Technology transfer

Technology transfer and commercialization are already at a central place in the history of the project. The Alta Voce startup originated in project member's JJA previous research group at IRCAM, Paris, thanks to collaborative projects REFLETS (ANR 2017) and ACTIVATE (ERC Proof of Concept 2020), and was a member of the first cohort of the CNRS Innovation's RISE startup accompaniment program. The technologies involved in the project (smile transformation) are patented by CNRS (*Method and Apparatus to modify voice timbre by shifting the formants of spectral envelopes*; EP2018/053433, invent), and Alta Voce has secured freedom to operate (FTO). Finally, the project's private partners Alta Voce and Comdata already have a successful working relation. The project will be able to capitalize on this successful history of valorization to facilitate the commercial exploitation of results at the end of the project.

One major instrument for preparing the transfer of technologies created in the project is the project's consortium agreement. We will use the ANRT consortium agreement model (UNICANR), which was specifically drafted for public/private collaboration. We will define in this agreement all the conditions favoring the technological transfer in the form of licensing or redemption of IP so that the researchers, in particular academics, will be remunerated in an equitable way according to their contribution. During the project, we will take great care in defining common results, and co-owners will decide whether or not to file patents. We will nevertheless favor filing single-partner patents for the sake of simplification.

At the end of the project, it is anticipated that results will be exploited either by the Alta Voce or the Comdata company. The goal of the project is to reach Technology-Readiness Level TRL 3-4 for the technologies of WP2. If successful, the prototype will be tested in pre-commercialization actions to be conducted after the project, for which the consortium will seek maturation funding such as BPI iLab or EIC Pathfinder, or internally via Comdata's technology transfer units. Finally, the objective of this project is to establish lasting links between the partners: the post-project can be the object of collaborations between the two companies and the project's academic members in the form of CIFRE contracts.

III. References related to the project

Akrich, M. (2006) La description des objets techniques In: Sociologie de la traduction, Textes fondateurs. Paris: Presses des Mines. • Arias, P., Soladié, C., Bouafif, O., Roebel, A., Séguier, R. & **Aucouturier, J.J**. (2020) Realistic manipulation of facial and vocal smiles in real-world video streams. IEEE Transactions on Affective Computing, Vol. 11(3) • Attanasi, G., **Curci**, Y., Llerena, P., Urso, G. (2019). Intrinsic vs. Extrinsic Motivators on Creative Collaboration: The Effect of Sharing Rewards, GREDEG Working Papers 2019-20. • Awad, E., Dsouza, S., Kim, R., Schulz, J., Henrich, J., Shariff, A., **Bonnefon, J. F**., & Rahwan, I. (2018). The moral machine experiment. Nature, 563, 59-64. • Boidron, L., Boudenia, K., Avena, C., Boucheix, J-M. and **Aucouturier, J.**J. (2016) Emergency medical triage decisions are swayed by computer-manipulated cues of physical dominance in caller's voice. Scientific Reports 6, 30219. • **Bonnefon, J. F**., Shariff, A., & Rahwan, I. (2020). The moral psychology of AI and the ethical opt-out problem. In S. M. Liao (Ed.) The Ethics of Artificial Intelligence. Oxford University Press. • **Bonnefon, J. F**., Shariff, A., & Rahwan, I. (2016). The social dilemma of autonomous vehicles. Science, 352(6293), 1573-1576. • **Boujendar, S**. (2018). Les conséquences de l'agressivité verbale quotidienne des clients sur l'épuisement des ressources et la performance des salariés de centres d'appels (Doctoral dissertation, Toulouse 1). • Callon, M., Lascoumes, P. & Barthe, Y (2001) Agir dans un monde incertain. Essai sur la démocratie technique, Paris, Le Seuil (collection "La couleur des idées"). • Chabin, T., Tio, G., Comte, A., Joucla, C., Gabriel, D., & Pazart, L. (2020). The relevance of a conductor competition for the study of emotional synchronization within and between groups in a natural musical setting. Frontiers in psychology, 10, 2954. • Clark, C. M., Tan, M. L., Murfett, U. M., Rogers, P. S., & Ang, S. (2019). The call center agent's performance paradox: A mixed-methods study of discourse strategies and paradox resolution. Academy of Management Discoveries, 5(2), 152-170. • Devillers, L., Kawahara, T., Moore, R. K., & Scheutz, M. (2020). Spoken language interaction with virtual agents and robots (SLIVAR): Towards effective and ethical interaction (Dagstuhl Seminar 20021). In Dagstuhl Reports (Vol. 10, No. 1). Schloss Dagstuhl-Leibniz-Zentrum für Informatik.• Doellgast, V., & O'Brady, S. (2020). Making call center jobs better: The relationship between management practices and worker stress. • Furnham, A., & Milner, R. (2013). The impact of mood on customer behavior: Staff mood and environmental factors. Journal of Retailing and Consumer Services, 20(6), 634-641. • Groth, M., Hennig-Thurau, T., & Walsh, G. (2009). Customer reactions to emotional labor: The roles of employee acting

strategies and customer detection accuracy. Academy of Management Journal, 52(5), 958-974. • Groth, M., Wu, Y., Nguyen, H., & Johnson, A. (2019). The moment of truth: A review, synthesis, and research agenda for the customer service experience. Annual Review of Organizational Psychology and Organizational Behavior, 6, 89-113. • Guerouaou, N., Vaiva, G., & **Aucouturier, J. J**. (in prep.). The shallow of your smile: The ethics of expressive vocal deepfakes. Psyarxiv myu8h • Hallinan, B., Brubaker, J. R., & Fiesler, C. (2020). Unexpected expectations: Public reaction to the Facebook emotional contagion study. New Media & Society, 22(6), 1076-1094. • Herjanto, H., & Franklin, D. (2019). Investigating salesperson performance factors: A systematic review of the literature on the characteristics of effective salespersons. Australasian Marketing Journal (AMJ), 27(2), 104-112. • Hidalgo, C. A., Orghiain, D., Canals, J. A., De Almeida, F., & Martín, N. (2021). How Humans Judge Machines. MIT Press. • Huang, M. H., & Rust, R. T. (2018). Artificial intelligence in service. Journal of Service Research, 21(2), 155-172. • Medaglia, J., Yaden, D., Helion, C. & Haslam, M. (2019) Moral attitudes and willingness to enhance and repair cognition with brain stimulation.Brain stimulation, 12(1):44–53. • Kain, A., & Van Santen, J. (2009, April). Using speech transformation to increase speech intelligibility for the hearing-and speaking-impaired. In 2009 IEEE International Conference on Acoustics, Speech and Signal Processing (pp. 3605-3608). • Kramer, A. D., Guillory, J. E., & Hancock, J. T. (2014). Experimental evidence of massive-scale emotional contagion through social networks. Proceedings of the National Academy of Sciences, 111(24), 8788-8790. • Latzko-Loth G. & Millerant F. (2012), Sociologie des usages et Science & Technology studies: un dialogue à poursuivre, in Vidal G. (dir.), La sociologie des usages, continuités et transformations, Hermès Lavoisier, pp. 119-150. • Lewin, J. E., & Sager, J. K. (2007). A process model of burnout among salespeople: Some new thoughts. Journal of Business Research, 60(12), 1216–1224. • Li, P., Benezeth, Y., Macwan, R., Nakamura, K., Gomez, R., Li, C., & Yang, F. (2020). Video-Based Pulse Rate Variability Measurement Using Periodic Variance Maximization and Adaptive Two-Window Peak Detection. Sensors, 20(10), 2752. • Massaro, S., & Pecchia, L. (2019). Heart rate variability (HRV) analysis: A methodology for organizational neuroscience. Organizational Research Methods, 22(1), 354-393 • McKinsey (2020) Coronavirus' impact on service organizations: Weathering the storm. McKinsey report, 29 April 2020 • Medaglia, J. D., Yaden, D. B., Helion, C., & Haslam, M. (2019). Moral attitudes and willingness to enhance and repair cognition with brain stimulation. Brain stimulation, 12(1), 44-53 • Miles, K., McMahon, C., Boisvert, I., Ibrahim, R., de Lissa, P., Graham, P., & Lyxell, B. (2017). Objective assessment of listening effort: Coregistration of pupillometry and EEG. Trends in hearing, 21, 2331216517706396. • Nova N. (2011), Les flops technologiques. Comprendre les échecs pour innover, FYP Editions. • Van den Oord, A., Dieleman, S., Zen, H., Simonyan, K., Vinyals, O., Graves, A., Kalchbrenner, N., Senior, A. & Kavukcuoglu, K. (2016) "Wavenet: A generative model for raw audio." arXiv preprint arXiv:1609.03499 • Kramer, P. & Brody, E.B. (1994) istening to prozac: A psychiatrist explores antidepressant drugs and the remaking of the self.Journal of Nervous and Mental Disease, 182(6):362. • Pizelle P., Hoffmann, J., Aubouy, M. & Verchère C. (2014), Innover par les usages, Editions d'Innovation. • Ponsot, E., Burred, J. J., Belin, P., & **Aucouturier, J. J.** (2018). Cracking the social code of speech prosody using reverse correlation. Proceedings of the National Academy of Sciences, 115(15), 3972-3977. • Rachman, L., Liuni, M., Arias, P., Lind, A., Johansson, P., Hall, L., Richardson, D., Watanabe, K. & Aucouturier, J. J. (2018). DAVID: An open-source platform for real-time transformation of infra-segmental emotional cues in running speech. Behavior research methods, 50(1), 323-343. • Reinero, D. A., Dikker, S., & Van Bavel, J. J. (2021). Inter-brain synchrony in teams predicts collective performance. Social cognitive and affective neuroscience, 16(1-2), 43-57. • Resnik, D. B. (2016). Employees as research participants: ethical and policy issues. IRB: Ethics & Human Research, 38(4), 11-16. • **Rey B., Simoncini N., Triclot M**., « « Les sciences humaines et sociales en recherche technologique : vers une démarche de conception fondée sur l'ethnographie », in Lamard P., Lequin Y. (éd.), La démocratie technique en travail, Presses de l'UTBM, 2021. • Rohrmann, S., Bechtoldt, M. N., Hopp, H., Hodapp, V., & Zapf, D. (2011). Psychophysiological effects of emotional display rules and the moderating role of trait anger in a simulated call center. Anxiety, Stress & Coping, 24(4), 421-438. • Schermer M. Ethics of pharmacological mood enhancement. Handbook of Neuroethics. New York, NY: Springer, pages 1177–1190, 2015. • Sliter, M., Sliter, K., & Jex, S. (2012). The employee as a punching bag: The effect of multiple sources of incivility on employee withdrawal behavior and sales performance. Journal of Organizational Behavior, 33(1), 121-139. • Song, Y., Liu, Y., Wang, M., Lanaj, K., Johnson, R. E., & Shi, J. (2018). A social mindfulness approach to understanding experienced customer mistreatment: A within-person field experiment. Academy of Management Journal, 61(3), 994-1020. • Stiegler, Bernard (2010), Ce qui fait que la vie vaut la peine d'être vécue: De la pharmacologie, Paris : Flammarion • **Triclot M**. (2013), « Milieu technique : généalogie d'un concept », Parrochia D. et Tirloni V. (dir.), Formes, systèmes et milieux techniques • Verbeek, P.P. (2011), Moralizing Technology: Understanding and Designing the Morality of Things. Chicago and London: University of Chicago Press. • Villano, W. J., Otto, A. R., Ezie, C. E., Gillis, R., & Heller, A. S. (2020). Temporal dynamics of real-world emotion are more strongly linked to prediction error than outcome. Journal of Experimental Psychology: General.• Von Hippel E. (2006), Democratizing Innovation, MIT Press. • Westerlund M. (2019) The emergence of deepfake technology: A review.Technology Innovation Management Review, 9(11). • Zimmer, M. (2010). "But the data is already public": on the ethics of research in Facebook. Ethics and information technology, 12(4), 313-325.