



Photo by Alina Grubnyak on Unsplash



**Trustworthy, Reliable and Engaging Scientific Communication
Approaches**

Fully developed scenario description for video scripting
and development



This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No 872855.

PROJECT DESCRIPTION

Acronym: **TRESKA**

Title: Trustworthy, Reliable and Engaging Scientific Communication Approaches

Coordinator: Erasmus University Rotterdam

Reference: 872855

Type: Research and Innovation Action (HORIZON 2020)

Program: Science with and for Society (SwafS)

Theme: (Science) Communication

Start: 01.01.2020

Duration: 28 months

Website: <https://trescaproject.eu>

E-Mail: tresca@eur.nl

Consortium: **Erasmus University Rotterdam**, The Netherlands (EUR), Coordinator
Agencia Estatal Consejo Superior de Investigaciones Científicas, Spain
(CSIC)
Observe Science in Society, Italy (OBS)
Zentrum Für Soziale Innovation GMBH, Austria (ZSI)
Science Business Publishing Limited, United Kingdom (SBIZ)
In a Nutshell, Kurzgesagt GmbH, Germany (KURZ)

DELIVERABLE DESCRIPTION

Number: **D1.4**

Title: **Fully developed scenario description for video scripting and development**

Lead beneficiary: **Erasmus University Rotterdam**

Work package: WP1

Dissemination level: Public (PU)

Type Report (R)

Due date: 30.06.2020

Submission date: [dd.mm.yyyy]

Authors: **Marina Tulin, EUR**
Elizabeth Steib, KURZ
Marc Zwiechowski, KURZ
Jason Pridmore, EUR

Contributors: **Sara Degli Esposti, CSIC**

Reviewers: **Janni Ekrem, SB; Jenny Ching-Wei Lee, SB**

Acknowledgement: This project has received funding from the European Union's Horizon 2020 Research and Innovation Action under Grant Agreement No 826497.

Disclaimer: The content of this publication is the sole responsibility of the authors and does not in any way represent the view of the European Commission or its services.

TABLE OF CONTENTS

1. Introduction	6
2. Rationale and process	6
2.1 Rationale and fit with the aims of TRESKA	6
2.2 Process and development of story outline	7
2.2.1 Focus area	7
2.2.2 Question	7
2.2.3 Narrative with thematic clusters	8
2.2.4 Development of story outline	8
3. Story outline	9
3.1 Origins and developments of communication and social relationships (Part 1)	9
3.2 How is digital communication affecting our lives? (Part 2)	9
3.3 Can digital communication sustain real connections? (Part 3)	10
4. Conclusion	10
5. Appendix: storyboard notes and literature	11

EXECUTIVE SUMMARY

This deliverable is the roadmap for a science communication video to be fully developed and produced in WP4. It presents the rationale for the direction of the video, such as its fit with the aims of TRESCA, the process of developing a reliable science communication video, and a provisional story outline. The story centres around the question of whether digital communication is enough to sustain human relationships. It zooms in on the differences between personal and digital communication and the role these play for social resilience.

This question directly emerges from the focus area elaboration of D1.3. It strategically addresses both TRESCA's focus on digitalisation and current developments towards more digitalisation in our societies. As such, the story outline speaks to an increasingly relevant problem, and as elaborated in other WP1 deliverables, the coronavirus pandemic can be considered an accelerator of the ongoing process towards more digitalisation of social connections. The story outline is structured in three parts. Part 1 presents the origins and historical developments of communication and social relationships. Part 2 zooms in on the unique benefits and drawbacks of digital communication for human connection, and Part 3 answers the central question of the video: Can digital communication sustain real connection?

1. INTRODUCTION

Science communication increasingly occurs via digital media. Social media platforms, such as Twitter or YouTube, are popular channels among science communicators. Despite these platforms being widely used for science communication, the level of validity and reliability of the information shared remains largely unclear. Consumers often do not know whether the information they see on these platforms is trustworthy. In addition, for science communicators it is difficult to assess whether the information they share on these platforms is effective. One of the truly innovative contributions of TRESKA is the improvement of (digital) science communication by producing an evidence-based and assessed science communication video. The actual video production and assessment occur in WP4. This deliverable serves as first input for the production of scripts and a storyboard. It details the rationale and process behind the development of enhanced video scripts and it presents the first draft of an evidence-based story outline.

2. RATIONALE AND PROCESS

2.1 Rationale and fit with the aims of TRESKA

One of the most basic components of successful science communication is the message. What do we seek to communicate? In this section, we lay out the rationale behind selecting the topic of TRESKA's science communication video. The topic needs to fulfil several requirements:

1. fit with TRESKA's thematic areas (digitalisation, environ-mental health, future of work)
2. aligns with expertise of TRESKA consortium
3. interesting to a general audience
4. relevant now and in the future (ca. 5 years)

The focus area elaboration in D1.3 revealed that all thematic areas of TRESKA, namely digitalisation, environ-mental health, and the future of work, are currently of very high relevance. The coronavirus pandemic has accelerated the already ongoing developments towards more digitalisation, and this magnified already existing concerns around digital safety, environ-mental health and the future of work. As such, a video on the consequences of increased digitalisation and these three topics fulfils many of the requirements stated above: it fits with TRESKA's thematic areas, is interesting to a general audience and is relevant now as well as in the near future.

A video on the consequences of digitalisation could take many shapes. It could focus on how to become digitally resilient against the risks of misinformation, how digitalisation affects people's wellbeing or how digital technologies help people progress in the work

context. In the end, we settled on a topic that is best aligned with the expertise of relevant consortium partners (EUR and KURZ). We needed to ensure that we are able to provide sufficient evidence-based information about the topic and that we are able to provide a satisfying take-away message. As elaborated in Section 2.2, the topic of ‘resilience in times of social isolation and digitalisation’ fulfilled these criteria, and the question that our science communication video seeks to answer is this: Can digital communication sustain real connection?

2.2 Process and development of story outline

The production of our evidence-based science communication video is an iterative process. The video scripts started as (1) a rough sketch of a *focus area*, which was refined to (2) a more *concrete question of interest*, (3) a first *narrative with thematic clusters* and eventually (4) the *initial story outline*. In each step of the process, the scripts were further refined and evaluated based on desk research of scientific literature. In other words, at each step of the process, we asked “Do our scripts hold up to scientific scrutiny?” In response to this question, the scripts were adjusted accordingly.

2.2.1 Focus area

The first step in developing an evidence-based science communication video was to define the *focus area*. Our starting point was D1.3, the trending topics analysis and focus area elaboration of the thematic areas of the TRESKA project. What emerged from this deliverable was the central role of digital technologies and their immense impact on our social lives, particularly during the coronavirus pandemic. Increasing digitalisation of social relationships is by no means a novel development, but the recent pandemic accelerated aspects of this development. In a time when individuals maintain important social connections primarily online, the initial focus area of our video scripts was on resilience in times of social isolation and digitalisation. An initial scan of the social-scientific literature revealed that there is sufficient scientific evidence to create a meaningful video in the broad area of digitalisation, social isolation and social resilience.

2.2.2 Question

The second step was to formulate a relevant and appropriate *question*. Several concerns needed to be balanced: The question needed to be broad enough to speak to the general public, but specific enough to produce a concrete take-away message. The question needed to be relevant now, but also in the near future (scope: ca. 5 years). The question needed to be ‘hot’ in popular culture, but it also needed to be answerable based on existing scientific literature. We selected a number of possible questions that met these criteria:

- Does digitalisation strengthen our connection or worsen it?

- How does digitalisation affect our work and home life?
- Can virtual communication replace real communication?
- Are we hardwired to have face to face contact?
- Are the borders between the online and offline world blurring?
- How does digitalisation affect our well-being?
- Are people who don't have strong social networks more vulnerable to fake news?
- Can virtual communication replace face to face communication?
- Does digital communication make us more lonely?
- What do we lose when all communication becomes digital?
- Is digital communication enough for social relationships?

Taking these questions as guidelines, we evaluated relevant literature once more. The focus this time was not only on whether there was sufficient literature available, but also which of these questions we are able to confidently answer, based on reliable and valid research. As a result of this evaluation, one concrete question emerged: Can digital communication sustain real connection?

2.2.3 *Narrative with thematic clusters*

The third step involved drawing a first *narrative with thematic clusters* around the question. The answer to the question of whether digital communication can sustain real connection is the main component of the video script. However, the lead-up to asking and answering this question requires careful attention as well. A video script is a narrative that typically starts by setting the stage before raising and answering the main question.

We structured the narrative into three thematic clusters. The first one covered the origins and development of communication, social relationships and support systems throughout history. The second one focused on how different aspects of digital communication affects people positively and negatively. The final thematic cluster raised and answered the main question. For each of the thematic clusters, we collected relevant research papers to understand whether there is enough research available to back up claims within the thematic areas. This work served as input for the first story outline.

2.2.4 *Development of story outline*

The fourth step involved refining the initial narrative with thematic clusters into a story outline that specifies how the information chronologically unfolds in the video. Additionally, two experts - one from EUR and one from KURZ - evaluated the individual literature sources in terms of relevance, validity and reliability to specify what type of information is best suited to be communicated in the video. The first draft of the resulting story outline is presented below. More research is planned to further sharpen the exact story content.

3. STORY OUTLINE

The story outline consists of three parts. Part 1 presents the origins and historical developments of communication and social relationships. Part 2 zooms in on the unique benefits and drawbacks of digital communication for human connection, and Part 3 answers the central question of the video: Can digital communication sustain real connection?

The story outline presented below is a 'clean' representation of the envisioned content of the video. Because the aim of this deliverable is to demonstrate not only the clean result, but also the messy process, we attach an Appendix with our collection of scientific literature, copies of abstracts and notes about the literature (see Appendix: Storyboard notes and literature).

3.1 Origins and developments of communication and social relationships (Part 1)

- I. Definition of communication/social support
- II. Why are relationships important for us in an evolutionary sense?
- III. How did communication/relationships change over time as connected groups of people were not only living closely together anymore?
- IV. How did things change with the digital age (e.g., email, smartphones)?

3.2 How is digital communication affecting our lives? (Part 2)

- I. General pros and cons, unique benefits/drawbacks for certain people
- II. Importance in the workcontext
- III. Importance in romantic, familial and friend relationships
- IV. Different experiences/approaches for different age groups

3.3 Can digital communication sustain real connections? (Part 3)

- I. Real life examples of such situations and studies about the effects, like romantic long distance relationships, refugees being separated from their families, communication in a crisis or war.
- II. Pandemic: unique global situation that forced a majority of the world to use digital communication almost exclusively for a prolonged period of time
- III. How does this affect people personally and as groups / social resilience as an overarching value of human society?
- IV. Do social bonds adapt to the means that are available?
- V. Prospective Conclusion: A message of hope that points to the adaptive capacity of humans

4. CONCLUSION

Science communication increasingly occurs via digital media and TRESKA seeks to positively contribute to this process by producing an evidence-based and assessed science communication video. The aim of this deliverable was to concisely present the process behind the development of an evidence-based story outline for such a video.

This deliverable highlights the importance of not only asking a relevant question, but also conducting adequate research to be able to answer it. The development of this first story outline remains an iterative process of drafting scripts and evaluating them based on scientific literature.

While much of the desk research has already been conducted, this story outline remains work in progress. It will be further refined for D4.1, which will present the final scripts for the video production.

5. APPENDIX: STORYBOARD NOTES AND LITERATURE

Part 1: Origin and development of Communication/Social relationships/Support systems throughout history

I. Definition of communication/social support

We are talking about social resilience here in the context of the ability to adapt to the changing means of communication.

#What is social resilience? Lessons Learned and Ways Forward, 2013.

https://www.academia.edu/3110553/What_is_Social_Resilience_Lessons_Learned_and_Ways_Forward

Abstract: *"Over the last decade, a growing body of literature has emerged which is concerned with the question of what form a promising concept of social resilience might take. In this article we argue that social resilience has the potential to be crafted into a coherent analytic framework that can build on scientific knowledge from the established concept of social vulnerability, and offer a fresh perspective on today's challenges of global change. Based on a critical review of recently published literature on the issue, we propose to define social resilience as being comprised of three dimensions: 1. Coping capacities – the ability of social actors to cope with and overcome all kinds of adversities; 2. Adaptive capacities – their ability to learn from past experiences and adjust themselves to future challenges in their everyday lives; 3. Transformative capacities – their ability to craft sets of institutions that foster individual welfare and sustainable societal robustness towards future crises. Viewed in this way, the search for ways to build social resilience – especially in the livelihoods of the poor and marginalized – is revealed to be not only a technical, but also a political issue. "*

In this context the concept of social support is also important.

#Social Support and Resilience to Stress From Neurobiology to Clinical Practice, 2007.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2921311/>

Quote: *"Social support has been described as "support accessible to an individual through social ties to other individuals, groups, and the larger community."14 The National Cancer Institute's Dictionary of Cancer Terms defines social support as "a network of family, friends, neighbors, and community members that is available in times of need to give psychological, physical, and financial help" (www.cancer.gov). Theoretical models of social support specify the following two important dimensions: (1) a structural dimension, which includes network size and frequency of social interactions, and (2) a functional dimension with emotional (such as receiving love and empathy) and instrumental (practical help such as gifts of money or assistance with child care) components.2 Most research has found that quality of relationships (functional*

dimension) is a better predictor of good health than quantity of relationships (structural dimension), although both are important."

In this context human communication is extremely important, since it is the medium through which humans transmit or exchange information, thoughts, intentions, feelings by means of language, signs, sounds, gestures and many other mechanisms we have discovered and devised.

Due to its complex nature, communication is studied by many different disciplines, such as semiotics, communication theory and cybernetics, ethnography of communication, linguistics, ethnomethodology, sociology, ordinary language philosophy, proxemics and kinesics to name a few.

Communication is essentially sharing among social beings. Therefore, it is also inherently a dynamic and adaptive process and open to development. It would be quite unfair if we limit it only to languages.

#Human Communication: Theoretical Explorations, 1974.

<https://books.google.de/books?id=gLbMCgAAQBAJ&q=%22human+communication%22#v=onepage&q&f=false>

Quote: *"First, then, what is communication? Strictly, the word means sharing. Communication is essentially social interaction. It is a sharing of a common language, cultural symbols, social habits, rituals, and many other forms of signs."*

#Theories of the development of human communication, 2013.

https://www.researchgate.net/publication/262449928_Theories_of_the_development_of_human_communication

Abstract: *"We consider evidence for innate motives for sharing rituals and symbols from animal semiotics, developmental neurobiology, physiology of prospective motor control, affective neuroscience and infant communication. Mastery of speech and language depends on polyrhythmic movements in narrative activities of many forms. Infants display intentional activity with feeling and sensitivity for the contingent reactions of other persons. Talk shares many of its generative powers with music and the other 'imitative arts.' Its special adaptations concern the capacity to produce and learn an endless range of sounds to label discrete learned understandings, topics and projects of intended movement."*

There are different types of communication: verbal and non-verbal.

Verbal communication refers mainly to language and is more effective for transmission of factual information.

We do not know how language came about since it dates back long time ago in human prehistory and we do not have direct evidence to drive conclusions from. However, there have been several views regarding how it might have originated. One branch postulates that it emerged gradually as a continuation of the more non-human animalistic behaviors to communicate. On the other hand, another view suggests that language was a *leap forward* and evolved in a single step.

#Crossing the Rubicon: Behaviorism, Language, and Evolutionary Continuity, 2020.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7186390/>

Abstract: *"Euan Macphail's work and ideas captured a pivotal time in the late 20th century when behavioral laws were considered to apply equally across vertebrates, implying equal intelligence, but it was also a time when behaviorism was challenged by the view that language was unique to humans, and bestowed a superior mental status. Subsequent work suggests greater continuity between humans and their forebears, challenging the Chomskyan assumption that language evolved in a single step ("the great leap forward") in humans. Language is now understood to be based on an amalgam of cognitive functions, including mental time travel, theory of mind, and what may be more broadly defined as imagination. These functions probably evolved gradually in hominin evolution and are present in varying degrees in non-human species. The blending of language into cognition provides for both interspecies differences in mental function, and continuity between humans and other species. What does seem to be special to humans is the ability to communicate the contents of imagination, although even this is not absolute, and is perhaps less adaptive than we like to think."*

#Language Evolution: A Changing Perspective, 2017.

https://www.researchgate.net/publication/313779014_Language_Evolution_A_Changing_Perspective

Abstract: *"From ancient times, religion and philosophy have regarded language as a faculty bestowed uniquely and suddenly on our own species, primarily as a mode of thought with communication as a byproduct. This view persists among some scientists and linguists and is counter to the theory of evolution, which implies that the evolution of complex structures is incremental. I argue here that language derives from mental processes with gradual evolutionary trajectories, including the generative capacities to travel mentally in time and space and into the minds of others. What may be distinctive in humans is the means to communicate these mental experiences along with knowledge gained from them."*

#What is Language and How Could it Have Evolved?, 2017.

https://www.researchgate.net/publication/317557264_What_is_Language_and_How_Could_it_Have_Evolved

Abstract: *"Unraveling the evolution of human language is no small enterprise. One could start digging somewhere in the largely unobservable past, working forwards to the present, hoping to*

surface in the right spot. Alternatively, one could start with the currently observed and well-established properties of human language, the phenotype of language, and work backwards, with these 'knowns' guiding the search for otherwise speculative historical 'unknowns'. In a recent issue of Trends in Cognitive Sciences, Corballis [1] appears confident that only the first strategy will serve. Evolutionary explanations necessarily are historical, but few evolutionary biologists faced with such a paucity of historical evidence would forge ahead without first defining what, exactly, the phenotype is that ultimately evolved [2]. Yet, Corballis criticizes what we actually know about the human language phenotype, because it does not conform to his speculations [3]. We believe that Corballis' odd research inversion suffers from misconceptions regarding what we know about both language and evolution."

Non-verbal communication refers to different cues (like facial expression, voice tone, gesture) and is more effective for transmission of emotions.

Face-to-face communication involves expressions beyond language; facial expressions, gestures, engagement, attentiveness etc. which might be missing in digital communication.

How substantial are the non-verbal cues in communication? What is their contribution?

Nonverbal cues are mostly what we use to transmit our emotions.

But why is the communication of emotions significant in the first place?

#Social Functionality of Human Emotion, 2012.

https://www.annualreviews.org/doi/full/10.1146/annurev.psych.121208.131605?url_ver=Z39.88-2003&rfr_id=ori%3Arid%3Acrossref.org&rfr_dat=cr_pub++0pubmed

Abstract: "Answers to the question "What are human emotions for?" have stimulated highly productive programs of research on emotional phenomena in psychology and neuroscience in the past decade. Although a variety of functions have been proposed and examined at different levels of abstraction, what is undeniable is that when emotional processing is compromised, most things social go awry. In this review we survey the research findings documenting the functions of emotion and link these to new discoveries about how emotion is accurately processed and transmitted. We focus specifically on emotion processing in dyads and groups, which reflects the current scientific trend. Within dyads, emotional expressions and learning and understanding through vicarious emotion are the phenomena of interest. Behavioral and brain mechanisms supporting their successful occurrence are evaluated. At the group level, group emotions and group-based emotions, two very different phenomena, are discussed, and mechanistic accounts are reviewed."

Quote: "What happens when an individual does not express his or her emotions to others (Butler et al. 2003, Gross & John 2003, Srivastava et al. 2009) or share them with others (Rimé 2007, Rimé et al. 2004)? And what happens when a person cannot understand the (typical) emotions expressed by other individuals, as may be caused by the incursion of specific brain lesions (e.g., Adolphs 2002, Adolphs et al. 2005), the development of diseases such as Parkinson's

(Wieser et al. 2006), autism (e.g., Clark et al. 2008, McIntosh 2006), or early maltreatment (Pollak 2008)? The conclusion is that, as a rule, what happens is not good. Disruptions in emotion processes—the abilities to understand, express, and experience emotion—lead to the loss of social support, disintegration of groups, and failure of economic viability."

There is a long line of research on nonverbal communication and it is still a rigorously studied topic today.

Research on nonverbal communication dates back to 1872, the publication of Charles Darwin's book *The Expression of the Emotions in Man and Animals*.

#The expression of the emotions in man and animals, 1872.

https://books.google.de/books?hl=en&lr=&id=TFRtLZSHMcYC&oi=fnd&pg=PR9&ots=Y3ntmt_vL7&sig=wz_cFDZRESwQwFIAGFpwwtUKzM&redir_esc=y#v=onepage&q&f=false

For a review of nonverbal cues and the various ways that they are interpreted:

#Nonverbal Communication, 2019.

https://www.annualreviews.org/doi/full/10.1146/annurev-psych-010418-103145?url_ver=Z39.88-2003&rfr_id=ori%3Arid%3Acrossref.org&rfr_dat=cr_pub++0pubmed

Abstract: *"The field of nonverbal communication (NVC) has a long history involving many cue modalities, including face, voice, body, touch, and interpersonal space; different levels of analysis, including normative, group, and individual differences; and many substantive themes that cross from psychology into other disciplines. In this review, we focus on NVC as it pertains to individuals and social interaction. We concentrate specifically on (a) the meanings and correlates of cues that are enacted (sent) by encoders and (b) the perception of nonverbal cues and the accuracy of such perception. Frameworks are presented for conceptualizing and understanding the process of sending and receiving nonverbal cues. Measurement issues are discussed, and theoretical issues and new developments are covered briefly. Although our review is primarily oriented within social and personality psychology, the interdisciplinary nature of NVC is evident in the growing body of research on NVC across many areas of scientific inquiry."*

Quote: *"Nonverbal communication (NVC) is the common denominator in social life; there is hardly any domain of social experience that is not connected to it. NVC is defined as behavior of the face, body, or voice minus the linguistic content, in other words, everything but the words. The study of human NVC is wide-ranging and includes inquiry into the following domains: evolutionary origins; developmental processes; physiological and neurological processes; intra- and interpersonal usages, correlates, antecedents, and consequences; group differences (e.g., culture, gender); the accuracy with which people are able to use NVC to convey intended meanings; and the accuracy with which people are able to understand the meanings of others' nonverbal cues."*

Mehrabian's theory of nonverbal communication became quite popular. He proposed the following:

- 7% of message pertaining to feelings and attitudes is in the words spoken.
- 38% of message pertaining to feelings and attitudes is paralinguistic (the way that the words are said).
- 55% of message pertaining to feelings and attitudes is in facial expression.

#Mehrabian A, Wiener M. Decoding of inconsistent communications, 1967.

<https://psycnet.apa.org/record/1967-08861-001>

Abstract: "Dealt with inconsistent communication of attitude in 2 components of a message. Positive, neutral, or negative attitudes communicated in single-word contents were each combined with 3 degrees of attitude communicated in tone of voice. It was found, consistent with the proposed hypothesis, that the variability of inferences about communicator attitude on the basis of information available in content and tone combined is mainly contributed by variations in tone alone. For example, when the attitude communicated in content contradicted the attitude communicated by a negative tone, the total message was judged as communicating a negative attitude. The limitations of the findings, as well as their implications for the double-blind theory of schizophrenia, are discussed."

#Mehrabian A, Ferris SR. Inference of attitudes from nonverbal communication in two channels, 1967.

<https://psycnet.apa.org/record/1967-10403-001>

Abstract: "3 degrees of attitude (i.e., positive, neutral, and negative) in facial expression were each combined with 3 degrees of attitude communicated vocally. The vocal communications of attitude were superimposed on a neutral word. In preparing the 2-component communications, the components were selected so that the degree of positive attitude communicated facially was equivalent to that communicated vocally-i.e., the independent effects of the 2 components were comparable. It was found that attitudes inferred from combined facial-vocal communications are a linear function of the attitudes communicated in each component, with the facial component receiving approximately 3/2 the weight received by the vocal component. Implications of the findings for more general attitude-communication problems are discussed."

Different mechanisms or aspects of non-verbal communication are:

- Eye gaze and eye movements
- Facial expressions
- Olfaction
- Touch
- Voice tone
- Posture
- Hormones

Studying how nonverbal communication codes for different aspects of communication is still a popular topic in research .

Some interesting correlations between non-communication and message/content are for example:

- Credibility of the speaker
- Engagement
- Attention

Their potential individual relevance and details about each issue will be discussed in more detail in Section 2: Different aspects of digital communication, General Pros and Cons.

2. Why are relationships important for us evolutionary?

We are also briefly covering the topic of relationships, social bonds and communities in general to establish their evolutionary relevance for humans and how communication and the development of communication are incorporated in the former topics.

Relationships are important for us because our ancestors figured out that it would not be practical to try to survive as a one man army. To overcome each evolutionary challenge, they had to find ways to live together and collaborate. Differences in relationships also reflect on the different mechanisms of communications. Humans use different means of communication when interacting with their children versus their colleagues. We have different mechanisms of approach based on the nature of our relationship with the receiver of our messages. Thus, as the nature of our relationships change and we need to interact with each other by different motivations, our ways of communication would probably adapt to it as well.

#Evolution and close relationships, 2015.

<https://psycnet.apa.org/record/2013-35884-001>

Abstract: *"Throughout history, humans have faced critical challenges that included finding a mate, keeping that mate, caring for kin, forming coalitions, and gaining some status. Solving each of these ancestral challenges involved forming a different type of social relationship. An evolutionary perspective suggests that there is a set of fundamentally different types of close relationships associated with different evolutionary challenges. These types include (a) mate attraction (e.g., dating couples), (b) mate retention (e.g., married couples), (c) kin care (e.g., family members), (d) coalition formation (e.g., friends), and (e) status (e.g., workplace relationships). Each type of ancestral challenge is associated with different kinds of evolutionary opportunities and costs, suggesting that different types of relationships may be governed by a different relationship-specific psychology. In this chapter, we review the principles of evolutionary psychology and their implications for close relationships. In this chapter, we consider social relationships from an evolutionary perspective. This perspective contends that, throughout history, humans have faced a set of core ancestral challenges, which include attracting a mate,*

keeping that mate, caring for kin, forming coalitions, and attaining status. An evolutionary perspective suggests that each type of challenge can be solved by forming different types of relationships. These relationship types include (a) dating couples, (b) married couples, (c) family members, (d) friends, and (e) coworkers. Each type of relationship is associated with different kinds of evolutionary opportunities and costs, meaning that people need different things from different types of intimate others and must provide different things to those intimate others. These needs and provisions vary systematically depending on the type of relationship. In this chapter, we first briefly review what it means to take an evolutionary perspective, reviewing some foundational principles. We then discuss each of the five types of relationships, reviewing relevant theory and findings. Finally, we discuss emerging themes and future directions in the study of social relationships from an evolutionary perspective. "

3. How did communication/relationships change over time as connected groups of people weren't only living closely together anymore?

Communication is shaped by culture. As humans adopt new ways of living, they also facilitate changes in culture and subsequently changes in communication.

How we communicate in turn also changes how we think. The fact that humans started to collaborate and move away from individualistic attitudes facilitated the development of communication. We needed to interact with each other and we adapted to it by building languages, nonverbal mechanisms etc. So how we interact with each other also changes us in fundamental ways. The fact that we are highly adaptable could also imply that it is not the means the most significant but rather our motivations of interacting with each other.

This research area could be especially relevant for our script and the potential hopeful conclusion that we might be able to draw: maybe we should focus on why we need the social interactions in the first place and what exactly human communication means. It could indeed be the motivation but not the means that determines the subjective or objective quality of the communication.

#Human thinking, shared intentionality, and egocentric biases, 2016.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4771814/>

Quote: *"The first evolutionary step occurred about 400,000 years ago, in early humans (the Homo heidelbergensis). Tomasello write that while humans' great ape ancestors lived, just as contemporary great apes, mostly individualistic and competitive lives in which individual intentionality served them just fine, early humans could no longer survive without collaborating with each other in dyadic units when out foraging. The result was a species-unique selection for and evolution of skills and motivations to engage in cooperative activities, which relied on a "dual-level structure" consisting of "joint goals" i.e. goals that both interactants shared and knew they shared with each other—and "joint attention" i.e. both interactants were attending to the*

same thing and knew they both did—forming a “joint intentionality” of the moment (Tomasello 2014: 33, 38).

Since the different individuals involved in cooperative activities with this structure still retained different perspectives and had to play different roles for both to achieve success in joint tasks, the need for early humans to coordinate their actions and attention referentially on external situations and entities arose. Tomasello argues that this initiated the evolution of new forms of communication such as pointing, pantomiming, and iconic gestures via which interactants now started to inform the other of aspects of the environment relevant for her/him to achieve the joint goal.

These new forms of communication and collaboration in turn led to new forms of thinking. For instance, in early humans’ cooperative communication, both the communicator of a message and the recipient had to “anticipate”, Tomasello writes, the “perspective of their partner, which required socially recursive inferences that embedded the intentional states of one partner within those of the other” (2014: 72). Individuals had to “think about their communicative partner thinking about their thinking” because the communicator had to determine how best to convey to the recipient her intention, and the recipient had to reconstruct the communicator’s intention by appealing to what she wanted him to know, Tomasello maintains (2014: 59). ”

Original source for the referred book of linguist and psychologist Tomasello:

#A Natural History of Human Thinking, 2014.

<https://www.jstor.org/stable/j.ctt6wpq11>

4. How did things change with the digital age (Email, smartphones, etc.)?

(NOTE: Here more research is needed and planned for the full development of the scripts in D4.1.)

#Social Relations and Technology: Continuity, Context, and Change

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5954608/>

Abstract: *“Social relations, although basic to human nature, health and well-being, have become increasingly complicated as a result of changing population demography and technology. In this essay, we provide a historical overview of social relations, especially as they affect older people. We briefly review the evolution of theory and measurement surrounding social relations as well as early empirical evidence. We consider how social relations have changed over time as well as continuity and change regarding basic characteristics of social relations. Of special interest is the emerging influence of technology on how people maintain contact, especially the changing ways people can use technology to increase, decrease, maintain, or avoid social relations. We consider both negative and positive aspects of these new technologies and their influence on health and well-being. Finally, we conclude that new and emerging technologies hold great promise for the future by overcoming traditional barriers to*

maintaining social contact, support exchange, and information acquisition. Nevertheless, we caution that these new technologies can have the dehumanizing effect of distance thus creating the potential for insensitivity and increased negativity. In sum, we are cautiously optimistic about the promise of technology to expand, but not replace, traditional forms of social contact."

#Smartphones and Close Relationships: The Case for an Evolutionary Mismatch

https://pubmed.ncbi.nlm.nih.gov/31002764/?from_term=%22social+bonds%22+adaptable&from_sort=pubdate&from_size=100&from_pos=4

Abstract: *"This article introduces and outlines the case for an evolutionary mismatch between smartphones and the social behaviors that help form and maintain close social relationships. As psychological adaptations that enhance human survival and inclusive fitness, self-disclosure and responsiveness evolved in the context of small kin networks to facilitate social bonds, promote trust, and enhance cooperation. These adaptations are central to the development of attachment bonds, and attachment theory is a middle-level evolutionary theory that provides a robust account of the ways human bonding provides for reproductive and inclusive fitness. Evolutionary mismatches operate when modern contexts cue ancestral adaptations in a manner that does not provide for their adaptive benefits. We argue that smartphones and their affordances, although highly beneficial in many circumstances, cue humans' evolved needs for self-disclosure and responsiveness across broad virtual networks and, in turn, have the potential to undermine immediate interpersonal interactions. We review emerging evidence on the topic of technofence, which is defined as the ways in which smartphone use may interfere with or intrude into everyday social interactions. The article concludes with an empirical agenda for advancing the integrative study of smartphones, intimacy processes, and close relationships."*

5. Digital communication vs social media

Here we need to make a distinction on what is digital communication and what is mistakenly regarded as digital communication.

NOTE: In the preliminary resource list we had a number of sources about the effects of social media. Since the main question of Part 3 was whether digital communication could be enough to sustain real-life relationships, we will focus more on technologies that are intended as a complete or almost complete substitute for a real conversation (like video chat or text messages/emails/phone calls) rather than social media platforms which are (in our opinion) rather intended as a supplementary technology in the first place. This will significantly narrow down the goal of research and also potentially the scope of possible content for the video.

Additionally we may indicate the importance of this in relation to social media when discussing this difference. There is a lot of research on the specific pros and cons of social media at present: studies about the negative effects of facebook and instagram are ubiquitous, while the fact that they are a way of transmitting information to masses very quickly and accurately is a critically positive aspect of social media.

#Interpersonal video communication as a site of human sociality, 2017.

<https://benjamins.com/catalog/prag.27.3.01har/fulltext/prag.27.3.01har.pdf>

Quote: *"Despite this, the literature on interpersonal video communication is limited. This is odd. After all, the literature on Computer-Mediated Communication (CMC) is enormous. However, the bulk of this research focuses on what are essentially textually-mediated forms of communication. There are many of these 'textualities' to be found. One can look at instant messaging, for example, at blogging, at Facebook posting, wiki entries and tweeting. All these entail typing, not gazing; reading and not listening; this seems to be the difference between Skyping and Facebooking, between blogging and Facetiming."*

Part 2: Different aspects of digital communication: How is digital communication affecting our lives?

5. General pros and cons, unique benefits/drawbacks for certain people

Video-based digital communication

General pros:

- Convenience; saves time, money and effort when being physically together is not possible
- Flexibility of digital communication makes it easier to maintain the sustainability of interactions

General cons:

- Lack of physical contact
- Digital illiteracy could hinder the communication for people who are not feeling comfortable using technology

Text-based digital communication:

General pros:

- Convenience and flexibility
- Gives time to go over and think about the information once more, so could be more concise and direct
- For individual who are shy and refrain from talking could be a way to sustain social connection

General cons:

- Delay in responses
- Lack of physical contact
- Digital illiteracy could hinder the communication for people who are not feeling comfortable using technology

- Missing most of the non verbal communication and open to interpretation, so might lead to misunderstandings

This section includes studies on different aspects of non-verbal communication to put them in context as to their significance for face to face and digital communication (like eye gaze and eye movements, facial expressions, olfaction, touch, voice tone, posture, hormones).

#Expanding Qualitative Research Interviewing Strategies: Zoom Video Communications, 2020.

https://www.researchgate.net/publication/341522576_Expanding_Qualitative_Research_Interviewing_Strategies_Zoom_Video_Communications

Abstract: *"The proliferation of new video conferencing tools offers unique data generation opportunities for qualitative researchers. While in-person interviews were the mainstay of data generation in qualitative studies, video conferencing programs, such as Zoom Video Communications Inc. (Zoom), provide researchers with a cost-effective and convenient alternative to in-person interviews. The uses and advantages of face-to-face interviewing are well documented; however, utilizing video conferencing as a method of data generation has not been well examined. The purpose of this paper is to examine the specific attributes of Zoom that contribute to high quality and in-depth qualitative interviews when in person interviewing is not feasible. While video conferencing was developed to facilitate long-distance or international communication, enhance collaborations and reduce travel costs for business these same features can be extended to qualitative research interviews. Overall, participants reported that Zoom video conferencing was a positive experience. They identified strengths of this approach such as: (1) convenience and ease of use, (2) enhanced personal interface to discuss personal topics (e.g., parenting), (3) accessibility (i.e., phone, tablet, and computer), (4) time-saving with no travel requirements to participate in the research and therefore more time available for their family. Video conferencing software economically supports research aimed at large numbers of participants and diverse and geographically dispersed populations."*

One of the general drawbacks of digital communication is the lack of physical contact. Touch is an intrinsic element in the communication of emotions and is encoded differently based on the type relationship.

Topography of social touching depends on emotional bonds between humans, 2015.

<https://www.pnas.org/content/112/45/13811>

Abstract: *"Touch is a powerful tool for communicating positive emotions. However, it has remained unknown to what extent social touch would maintain and establish social bonds. We asked a total of 1,368 people from five countries to reveal, using an Internet-based topographical self-reporting tool, those parts of their body that they would allow relatives, friends, and strangers to touch. These body regions formed relationship-specific maps in which the total area was directly related to the strength of the emotional bond between the participant*

and the touching person. Cultural influences were minor. We suggest that these relation-specific bodily patterns of social touch constitute an important mechanism supporting the maintenance of human social bonds."

Gaze:

#The "Social Gaze Space": A Taxonomy for Gaze-Based Communication in Triadic Interactions, 2018.

<https://www.frontiersin.org/articles/10.3389/fpsyg.2018.00226/full>

Abstract: *"Humans substantially rely on non-verbal cues in their communication and interaction with others. The eyes represent a "simultaneous input-output device": While we observe others and obtain information about their mental states (including feelings, thoughts, and intentions-to-act), our gaze simultaneously provides information about our own attention and inner experiences. This substantiates its pivotal role for the coordination of communication. The communicative and coordinative capacities – and their phylogenetic and ontogenetic impacts – become fully apparent in triadic interactions constituted in its simplest form by two persons and an object. Technological advances have sparked renewed interest in social gaze and provide new methodological approaches. Here we introduce the 'Social Gaze Space' as a new conceptual framework for the systematic study of gaze behavior during social information processing. It covers all possible categorical states, namely 'partner-oriented,' 'object-oriented,' 'introspective,' 'initiating joint attention,' and 'responding joint attention.' Different combinations of these states explain several interpersonal phenomena. We argue that this taxonomy distinguishes the most relevant interactional states along their distinctive features, and will showcase the implications for prominent social gaze phenomena. The taxonomy allows to identify research desiderates that have been neglected so far. We argue for a systematic investigation of these phenomena and discuss some related methodological issues."*

Posture:

Posture can indicate the level of engagement for instance.

#Posture as a Predictor of Learner's Affective Engagement, 2007.

<https://escholarship.org/content/qt7hs9v2hr/qt7hs9v2hr.pdf>

Abstract: *"This research demonstrates the utility of automatically monitoring a student's posture to track the affective states of boredom (low engagement) and flow (high engagement), which have been shown to influence learning. After a tutoring session with AutoTutor, the affective states of the student were rated by the learner, a peer, and two trained judges. Our results indicated that the affective state of flow was manifested through heightened pressure exerted on the seat of a pressure sensitive chair. Boredom, in turn, was associated with an increase in the pressure exerted on the back coupled with a rapid change in pressure on the seat, perhaps indicative of a state of restlessness. We also investigated the diagnosticity of each*

of the posture features and the reliability of a computer automatically discriminating episodes of boredom versus flow, which is a major discrimination in any affect-sensitive tutoring system."

Vocal tone:

#"Worth a Thousand Words": Absolute and Relative Decoding of Nonlinguistic Affect Vocalizations, 2009.

<https://pubmed.ncbi.nlm.nih.gov/19485607/>

Abstract: *"The authors compared the accuracy of emotion decoding for nonlinguistic affect vocalizations, speech-embedded vocal prosody, and facial cues representing 9 different emotions. Participants (N = 121) decoded 80 stimuli from 1 of the 3 channels. Accuracy scores for nonlinguistic affect vocalizations and facial expressions were generally equivalent, and both were higher than scores for speech-embedded prosody. In particular, affect vocalizations showed superior decoding over the speech stimuli for anger, contempt, disgust, fear, joy, and sadness. Further, specific emotions that were decoded relatively poorly through speech-embedded prosody were more accurately identified through affect vocalizations, suggesting that emotions that are difficult to communicate in running speech can still be expressed vocally through other means. Affect vocalizations also showed superior decoding over faces for anger, contempt, disgust, fear, sadness, and surprise. Facial expressions showed superior decoding scores over both types of vocal stimuli for joy, pride, embarrassment, and "neutral" portrayals. Results are discussed in terms of the social functions served by various forms of nonverbal emotion cues and the communicative advantages of expressing emotions through particular channels."*

Olfaction:

#Chemosignals Communicate Human Emotions, 2012.

https://www.researchgate.net/publication/231225277_Chemosignals_Communicate_Human_Emotions

Abstract: *"Can humans communicate emotional states via chemical signals? In the experiment reported here, we addressed this question by examining the function of chemosignals in a framework furnished by embodied social communication theory. Following this theory, we hypothesized that the processes a sender experiences during distinctive emotional states are transmitted to receivers by means of the chemicals that the sender produces, thus establishing a multilevel correspondence between sender and receiver. In a double-blind experiment, we examined facial reactions, sensory-regulation processes, and visual search in response to chemosignals. We demonstrated that fear chemosignals generated a fearful facial expression and sensory acquisition (increased sniff magnitude and eye scanning); in contrast, disgust chemosignals evoked a disgusted facial expression and sensory rejection (decreased sniff magnitude, target-detection sensitivity, and eye scanning). These findings underline the neglected*

social relevance of chemosignals in regulating communicative correspondence outside of conscious access."

#On the Communicative Function of Body Odors: A Theoretical Integration and Review, 2017.

https://www.researchgate.net/publication/308900072_On_the_Communicative_Function_of_Body_Odors_A_Theoretical_Integration_and_Review

Abstract: *"Humans use multiple senses to navigate the social world. Among these, our sense of smell is arguably the most underestimated one. One intriguing function of the sense of smell is its social communicative function. Research has shown that human odors can convey information about a range of states (e.g., emotions, sickness) and traits (e.g., individuality, gender). Yet, what underlies the communicability of these states and traits via smell? We aim to fill this explanatory gap by furnishing a framework that highlights the dynamic and flexible aspects of human olfactory communication. In particular, we explain how multiple-message body odors, associative learning (i.e., the systematic co-occurrence of certain odorants with state- or trait-related information), and top-down contextual influences could interact to shape human odor perception. Not only does our model help to integrate past research on human olfactory communication, but it also opens new avenues for future research on this fascinating, yet to date poorly understood field."*

Facial expressions:

#Facial Displays Are Tools for Social Influence, 2018.

https://pubmed.ncbi.nlm.nih.gov/29544997/?from_term=evolution+human+communication&from_filter=simsearch2.ffrft&from_filter=pubt.review&from_sort=pubdate&from_size=100&from_pos=44

Abstract: *"Based on modern theories of signal evolution and animal communication, the behavioral ecology view of facial displays (BECV) reconceives our 'facial expressions of emotion' as social tools that serve as lead signs to contingent action in social negotiation. BECV offers an externalist, functionalist view of facial displays that is not bound to Western conceptions about either expressions or emotions. It easily accommodates recent findings of diversity in facial displays, their public context-dependency, and the curious but common occurrence of solitary facial behavior. Finally, BECV restores continuity of human facial behavior research with modern functional accounts of non-human communication, and provides a non-mentalist account of facial displays well-suited to new developments in artificial intelligence and social robotics."*

Hormonal responses:

Oxytocin:

#Intranasal Oxytocin Increases Covert Attention to Positive Social Cues, 2013.

<https://pubmed.ncbi.nlm.nih.gov/23146328/>

Abstract: *“Reaction times (RTs) in the dot-probe paradigm revealed a pronounced shift of attention towards happy facial expressions presented for 100 ms after OT administration, whereas there were no OT-induced effects for longer presentation times (500 ms). The results could not be attributed to modulations of overt visual attention as no substance effects on gazes towards the facial target were observed.”*

#Instant messages vs. speech: hormones and why we still need to hear each other

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3277914/>

Abstract: *“Human speech evidently conveys an adaptive advantage, given its apparently rapid dissemination through the ancient world and global use today. As such, speech must be capable of altering human biology in a positive way, possibly through those neuroendocrine mechanisms responsible for strengthening the social bonds between individuals. Indeed, speech between trusted individuals is capable of reducing levels of salivary cortisol, often considered a biomarker of stress, and increasing levels of urinary oxytocin, a hormone involved in the formation and maintenance of positive relationships. It is not clear, however, whether it is the uniquely human grammar, syntax, content and/or choice of words that causes these physiological changes, or whether the prosodic elements of speech, which are present in the vocal cues of many other species, are responsible. In order to tease apart these elements of human communication, we examined the hormonal responses of female children who instant messaged their mothers after undergoing a stressor. We discovered that unlike children interacting with their mothers in person or over the phone, girls who instant messaged did not release oxytocin; instead, these participants showed levels of salivary cortisol as high as control subjects who did not interact with their parents at all. We conclude that the comforting sound of a familiar voice is responsible for the hormonal differences observed and, hence, that similar differences may be seen in other species using vocal cues to communicate.”*

Moreover, the mechanisms of non-verbal communication are not functioning as a stand alone and are generally also dependent on each other. Thus, non verbal communication is actually quite a complex phenomenon.

Effects of Oxytocin on gaze:

#Oxytocin Differentially Modulates Eye Gaze to Naturalistic Social Signals of Happiness and Anger, 2013.

https://pubmed.ncbi.nlm.nih.gov/23117026/?from_term=non-verbal+cues+gaze+video+&from_sort=pubdate&from_size=100&from_pos=3

Abstract: *“A number of previous studies has shown that oxytocin (OT) promotes facial emotion recognition and enhances eye gaze to facial stimuli in humans. Other studies report valence-specific effects of OT, supporting the proposed prosocial role of OT in social interactions. In the present study, we tested the hypothesis whether OT might selectively enhance eye gaze to positive, approach-related, but not to negative, threat-related social cues. In a*

placebo-controlled, double-blind, between-subject design, we assessed the effects of intranasal OT administration (24 IU) in 62 healthy male volunteers on eye gaze toward the eyes of neutral, positive (happy) and negative (angry) facial expressions compared with placebo. In order to capture the dynamics of facial expressions, we used video sequences showing neutral faces gradually displaying a specific emotion. In line with previous studies, OT increased eye gaze toward neutral facial expressions. Moreover, under OT treatment, eye gaze remained increased when the face showed a happy facial expression, but in contrast decreased when the face displayed an angry expression. These results support the notion that OT differentially modulates visual attention toward social signals of positive approach and threat and thereby contributes to the modulation of non-verbal interpersonal communication."

Evolutionary aspect of gaze:

#Unique morphology of the human eye and its adaptive meaning: comparative studies on external morphology of the primate eye, 2001.

https://www.researchgate.net/publication/12012997_Unique_morphology_of_the_human_eye_and_its_adaptive_meaning_Comparative_studies_on_external_morphology_of_the_primate_eye

Abstract: *"In order to clarify the morphological uniqueness of the human eye and to obtain cues to understanding its adaptive significance, we compared the external morphology of the primate eye by measuring nearly half of all extant primate species. The results clearly showed exceptional features of the human eye: (1) the exposed white sclera is void of any pigmentation, (2) humans possess the largest ratio of exposed sclera in the eye outline, and (3) the eye outline is extraordinarily elongated in the horizontal direction. The close correlation of the parameters reflecting (2) and (3) with habitat type or body size of the species examined suggested that these two features are adaptations for extending the visual field by eyeball movement, especially in the horizontal direction. Comparison of eye coloration and facial coloration around the eye suggested that the dark coloration of exposed sclera of nonhuman primates is an adaptation to camouflage the gaze direction against other individuals and/or predators, and that the white sclera of the human eye is an adaptation to enhance the gaze signal. The uniqueness of human eye morphology among primates illustrates the remarkable difference between human and other primates in the ability to communicate using gaze signals."*

This study brings up an interesting question: If we adapt to gaze, can we adapt to new means?

And following from that thought: How much can we adapt the non-verbal cues to digital communication? Can we develop the current video communication tools to better transmit nonverbal cues?

#Eye-to-Eye Contact for Life-Sized Videoconferencing, 2014.

https://www.researchgate.net/publication/274837651_Eye-to-Eye_Contact_for_Life-Sized_Videoconferencing

Abstract: *"Videoconferencing systems available for end users do not allow for eye-to-eye contact between participants. The different locations of video camera and video display make it impossible to directly look into each others eyes. This issue is known as the lack of mutual gaze. Combined with a lack of a life-sized video image of the communication partner videoconferencing becomes an artificial experience leading to decreased communication quality, empathy and trust. In this work, we present life-sized videoconferencing solution supporting mutual gaze and report on the experiences made with our system in empirical evaluations."*

#GAZE-2: Conveying Eye Contact in Group Video Conferencing Using Eye-Controlled Camera Direction

<https://dl.acm.org/doi/pdf/10.1145/642611.642702>

Abstract: *"GAZE-2 is a novel group video conferencing system that uses eye-controlled camera direction to ensure parallaxfree transmission of eye contact. To convey eye contact, GAZE-2 employs a video tunnel that allows placement of cameras behind participant images on the screen. To avoid parallax, GAZE-2 automatically directs the cameras in this video tunnel using an eye tracker, selecting a single camera closest to where the user is looking for broadcast. Images of users are displayed in a virtual meeting room, and rotated towards the participant each user looks at. This way, eye contact can be conveyed to any number of users with only a single video stream per user. We empirically evaluated whether eye contact perception is affected by automated camera direction, which causes angular shifts in the transmitted images. Findings suggest camera shifts do not affect eye contact perception, and are not considered highly distractive."*

Consistency Between Verbal and Non-Verbal Affective Cues: A Clue to Speaker Credibility, 2017.

https://pubmed.ncbi.nlm.nih.gov/26892724/?from_term=%22non-verbal+cues%22&from_sort=pubdate&from_size=100&from_pos=31

Abstract: *"Listeners are exposed to inconsistencies in communication; for example, when speakers' words (i.e. verbal) are discrepant with their demonstrated emotions (i.e. non-verbal). Such inconsistencies introduce ambiguity, which may render a speaker to be a less credible source of information. Two experiments examined whether children make credibility discriminations based on the consistency of speakers' affect cues. In Experiment 1, school-age children (7- to 8-year-olds) preferred to solicit information from consistent speakers (e.g. those who provided a negative statement with negative affect), over novel speakers, to a greater extent than they preferred to solicit information from inconsistent speakers (e.g. those who provided a negative statement with positive affect) over novel speakers. Preschoolers (4- to 5-year-olds) did not demonstrate this preference. Experiment 2 showed that school-age children's ratings of speakers were influenced by speakers' affect consistency when the attribute being judged was related to information acquisition (speakers' believability, "weird" speech), but not general characteristics (speakers' friendliness, likeability). Together, findings suggest that school-age*

children are sensitive to, and use, the congruency of affect cues to determine whether individuals are credible sources of information."

#Attractiveness Is Multimodal: Beauty Is Also in the Nose and Ear of the Beholder, 2017.

https://pubmed.ncbi.nlm.nih.gov/28572777/?from_term=%22non-verbal+communication%22&from_filter=pubt.review&from_sort=pubdate&from_size=100&from_pos=17

Abstract: *"Attractiveness plays a central role in human non-verbal communication and has been broadly examined in diverse subfields of contemporary psychology. Researchers have garnered compelling evidence in support of the evolutionary functions of physical attractiveness and its role in our daily lives, while at the same time, having largely ignored the significant contribution of non-visual modalities and the relationships among them. Acoustic and olfactory cues can, separately or in combination, strongly influence the perceived attractiveness of an individual and therefore attitudes and actions toward that person. Here, we discuss the relative importance of visual, auditory and olfactory traits in judgments of attractiveness, and review neural and behavioral studies that support the highly complex and multimodal nature of person perception. Further, we discuss three alternative evolutionary hypotheses aimed at explaining the function of multiple indices of attractiveness. In this review, we provide several lines of evidence supporting the importance of the voice, body odor, and facial and body appearance in the perception of attractiveness and mate preferences, and therefore the critical need to incorporate cross-modal perception and multisensory integration into future research on human physical attractiveness."*

Quote: "Given that ecologically relevant information is perceptually available in others' voices and body odors, it is likely that voice and odor play a salient role in our everyday decision-making, and that utilizing and integrating information from the visual, acoustic and olfactory channels may improve social communication. Thus, the importance of modalities other than vision in social perception should not be neglected in scientific research."

Non-verbal cues could also be confounding the message:

We rely a lot on the non-verbal cues when communicating. In some cases this might cause misinterpretations since 'who says it' becomes more significant than 'what the message is'. Especially in the cases where factual information is relevant and important to transmit, non-verbal cues could hinder the communication.

Accurate transmission of factual information is significant in the work environment.

Nonverbal cues can introduce social biases as well:

Taken together with the attractiveness study above, this might constitute an example how the nonverbal cues can cause biases.

#Explaining Financial and Prosocial Biases in Favor of Attractive People: Interdisciplinary Perspectives From Economics, Social Psychology, and Evolutionary Psychology, 2016.

<https://pubmed.ncbi.nlm.nih.gov/27283466/>

It is true that by means of digital communication, some channels of nonverbal communication are eliminated. This would constitute a full-blown drawback if we were only to use nonverbal cues in effort to understand and relate to the people with whom we are interacting. However, communication is not a one way road, it is not only about transmitting but also about perceiving. And perceiving is subjective and shaped by personal experiences. Consequently, a nonverbal cue could have quite different meanings for different people. Our prejudices and impressions are also the consequences of nonverbal communication. Digital communication could therefore facilitate a more objective evaluation of what a person would like to convey without the confounding interpretations by the receiver.

#Spotting prejudice with nonverbal behaviours, 2016.

<https://dl.acm.org/doi/10.1145/2971648.2971703>

Abstract: *"Despite prejudice cannot be directly observed, nonverbal behaviours provide profound hints on people's inclinations. In this paper, we use recent sensing technologies and machine learning techniques to automatically infer the results of psychological questionnaires frequently used to assess implicit prejudice. In particular, we recorded 32 students discussing with both white and black collaborators. Then, we identified a set of features allowing automatic extraction and measured their degree of correlation with psychological scores. Results confirmed that automated analysis of nonverbal behaviour is actually possible thus paving the way for innovative clinical tools and eventually more secure societies."*

Quote: *"The analysed features were partly derived from previous psychological research, that identified indices such as interpersonal distance, body posture and movements as especially relevant indicators of prejudice."*

#The nonverbal mediation of self-fulfilling prophecies in interracial interaction, 1974.

<https://www.sciencedirect.com/science/article/abs/pii/0022103174900596>

Abstract: *"Two experiments were designed to demonstrate the existence of a self-fulfilling prophecy mediated by nonverbal behavior in an interracial interaction. The results of Experiment 1, which employed naive, white job interviewers and trained white and black job applicants, demonstrated that black applicants received (a) less immediacy, (b) higher rates of speech errors, and (c) shorter amounts of interview time. Experiment 2 employed naive, white applicants and trained white interviewers. In this experiment subject-applicants received behaviors that approximated those given either the black or white applicants in Experiment 1. The main results indicated that subjects treated like the blacks of Experiment 1 were judged to perform less adequately and to be more nervous in the interview situation than subjects treated like the whites. The former subjects also reciprocated with less proximate positions and rated the*

interviewers as being less adequate and friendly. The implications of these findings for black unemployment were discussed."

How much of this non-verbal communication could be present in digital communication?

The Role of the Human Mirror Neuron System in Supporting Communication in a Digital World, 2017.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5427119/>

Abstract: *"Humans use both verbal and non-verbal communication to interact with others and their environment and increasingly these interactions are occurring in a digital medium. Whether live or digital, learning to communicate requires overcoming the correspondence problem: There is no direct mapping, or correspondence between perceived and self-produced signals. Reconciliation of the differences between perceived and produced actions, including linguistic actions, is difficult and requires integration across multiple modalities and neuro-cognitive networks. Recent work on the neural substrates of social learning suggests that there may be a common mechanism underlying the perception-production cycle for verbal and non-verbal communication. The purpose of this paper is to review evidence supporting the link between verbal and non-verbal communications, and to extend the hMNS literature by proposing that recent advances in communication technology, which at times have had deleterious effects on behavioral and perceptual performance, may disrupt the success of the hMNS in supporting social interactions because these technologies are virtual and spatiotemporal distributed nature."*

6. Importance in a workcontext

Digital communication has proved itself to be especially useful in professional relations and business communication. As the professional networks of individuals get more and more global, sustaining face-to-face communication gets more difficult, in terms of time and expenses. Also new technologies invited new practices in business like home-officing. One recent example could be the explosion of Zoom use during the Covid19 pandemic.

NOTE: More research is necessary and planned from the consortium in relation to D4.1 on this topic.

7. Importance in romantic and friendly relationships

In case of more intimate and emotional interactions like friendship and romantic relationships, it is generally more important to transmit and perceive the feelings accurately.

Language is generally effective to transmit factual information. This might not hold true when it comes to communicating emotions. A common argument against digital communication concerns its inefficiency to express and perceive emotions, since we rely on many different means when we express emotions inaccessible through digital communication, like voice tone and touch. Even the sole physical proximity could have positive effects.

There are many studies showing the positive effects of touch and physical proximity:

#Effects of different kinds of couple interaction on cortisol and heart rate responses to stress in women, 2007.

<http://portal.uni-freiburg.de/psychologie/abteilungen/psychobio/team/publikationen/Ditze-n-PNEC-07.pdf>

Quote: *"Women with positive physical partner contact before stress exhibited significantly lower cortisol and heart rate responses to stress but no different plasma oxytocin levels compared to women who received social support or no social interaction. Verbal social support alone was not associated with reduced stress responsiveness. Our results are in line with previous human studies indicating reduced responsiveness to verbal social support by a spouse in women. More importantly, these findings imply a direct protective effect of touch on stress-related neurobiological systems as a possible underlying mechanism of health beneficial effects of positive couple interaction."*

However, there are also cases where emotions could have confounding effects and hinders the communication.

NOTE: More research is necessary and planned from the consortium in relation to D4.1 on this topic.

8. Different experiences/approaches for different age groups

NOTE: More research is necessary and planned from the consortium in relation to D4.1 on this topic.

Part 3: Can digital communication sustain real connection?

9. Real life examples of such situations and studies about the effects, like romantic long distance relationships, refugees being separated from their families, communication in a crisis or war.

Digital communication is actually quite successful in cases when physical proximity is not available. When people live abroad or have to stay away from their families for a limited

time, they generally resort to digital communication to sustain the connection and report positive feedback about it. Besides, there could also be cases where people actually refrain from face-to-face communication or it is actually more useful.

This is a partial list of examples that will be discussed with studies over the following pages:

- People who live abroad or are constantly away from their families/friends
- People who has to stay away from their families for a given period of time, such as military service, relocations due to jobs or cultural practices
- Elderly living in nursing homes
- Long distance relationships
- Video-therapies with psychologists

NOTE: More research is necessary and planned from the consortium in relation to D4.1 on this topic and will expand this list in the ongoing process.

One example where digital communication is quite useful is video-consultation. One area where video-consulting could be useful, is within mental health. As mental health problems have become more common, future consultations with a practitioner could possibly become more challenging to achieve. As a result, technology-based mental health interventions have become an increasingly used practice in recent years.

Video communication as a tool for psychosocial support for people recovering from severe mental disorder: social workers' experiences, 2019.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6789197/pdf/mh-05-2019.08.09.pdf>

Quote: *"The social workers stated that video technology gave them the opportunity to make changes in their working practices with the citizens. They also felt they were better able to meet the citizens' need to improve their everyday lives. The social workers found that video technology was less intrusive than a physical visit to the citizen's home. The technology helps to promote the client's recovery process."*

Similar practices are present for elderly living in and distant from their families.

#Use of Videophones for Distant Caregiving: An Enriching Experience for Families and Residents in Long-Term Care, 2008.

https://www.researchgate.net/publication/51423436_Use_of_videophones_for_distant_care_giving_-_An_enriching_experience_for_families_and_residents_in_long-term_care

Abstract: *"The objective of this study was to explore the role of videophone technology in enhancing the distant caregiving experience of and communication between residents of a long-term care facility and their family members. Ten participants-4 residents of an independent retirement facility and 6 family members-were recruited. A videophone was installed in each resident's apartment, and another was mailed to the remote family member. Participants were*

asked to conduct a video call at least once per week for 3 months. Exit interviews assessed general impressions of videophone communication, the relationship between residents and family members, stress, burden, and isolation. Participants were enthusiastic and emphasized a sense of closeness, the inclusion of the resident in family interactions, and reduced feelings of guilt and isolation as key benefits. New models of care are needed to challenge the existing paradigm, which often excludes distant caregivers from the care process. Technology can facilitate this process by bridging geographic distance."

Digital communication helps families to sustain connection when one part of the family lives abroad:

#Emotional streaming and transconnectivity: Skype and emotion practices in transnational families in Ireland, 2015.

<http://mural.maynoothuniversity.ie/9037/1/RK-Emotional-2015.pdf>

Abstract: *"In this article I explore how transnational families, living in Ireland, use Skype to stay in touch with their loved ones. From 2010 to 2012, data were collected from a purposive, but broad sample of 36 qualitative ethnographic interviews with mixed couples (one partner identifies as Irish and one does not), throughout various parts of the Republic of Ireland. I outline how the use of Skype allows transnational families to create spaces of transconnectivity as they practise simultaneous and ongoing belonging across significant temporal and geographic distances. This affects how people 'do' emotions. These emotion practices often consist not only of 'affect storage' but also of what I call emotional streaming, promoting ongoing interaction over distance, which includes keeping Skype turned on for long periods of time. Through these attempts to try to recreate everyday practices via continuous use of Skype, transnational emotions of love and longing are deintensified."*

#Video-Mediated Communication to Support Distant Family Connectedness, 2012.

<https://journals.sagepub.com/doi/abs/10.1177/1054773812446150>

Abstract: *"It can be difficult to maintain family connections with geographically distant members. However, advances in computer-human interaction (CHI) systems, including video-mediated communication (VMC) are emerging. While VMC does not completely substitute for physical face-to-face communication, it appears to provide a sense of virtual copresence through the addition of visual and contextual cues to verbal communication between family members. The purpose of this study was to explore current patterns of VMC use, experiences, and family functioning among self-identified VMC users separated geographically from their families. A total of 341 participants (ages 18 to above 70) completed an online survey and Family APGAR. Ninety-six percent of the participants reported that VMC was the most common communication method used and 60% used VMC at least once/week. The most common reason cited for using VMC over other methods of communication was the addition of visual cues. A significant difference between the Family APGAR scores and the number of positive comments about VMC experience was also found. This exploratory study provides insight into the acceptance of VMC and its usefulness in maintaining connections with distant family members."*

When couples are separated due to military service:

#Something to talk about: Topics of conversation between romantic partners during military deployments, 2018.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5858224/>

Abstract: *"Long-distance communication has been frequently identified as essential to military couples trying to maintain their relationship during a military deployment. Little quantitative research, however, has assessed the types of topics discussed during such communication and how those topics relate to overall relationship satisfaction. The current study draws on a sample of 56 Army couples who provided data through online surveys while the service member was actively deployed. These couples provided information on current marital satisfaction, topics discussed during deployment (problem talk, friendship talk, love talk), and how they communicated via synchronous media (e.g., phone calls, video calls) and letters during deployment. Non-parametric Friedman tests followed by paired t-tests revealed that synchronous communication was primarily utilized for friendship talk, whereas letters included friendship talk and love talk in similar amounts. Both synchronous communication and letters included less problem talk than other topics. In mixed level modeling, only topics of communication for synchronous media (not for letters) were related to relationship satisfaction. Love talk via synchronous media was related to higher relationship satisfaction, whereas problem talk via synchronous media was related to less relationship satisfaction. The current study offers the first quantitative assessment of topics within deployment communication media and associations with relationship satisfaction."*

Long distance relationships:

#Living long-distance relationships through computer-mediated communication, 2009.

<https://doaj.org/article/6dca502863374ca29ff32da850ed6c5d>

Abstract: *"Overseas Filipino Workers (OFWs) and their loved ones in the Philippines manage to have dynamic relationships despite physical distance with Computer-Mediated Communication (CMC) or the use of new media (the Internet and cellular phone). Theoretically guided by Marshall McLuhan and Stuart Hall, this paper presents three case studies that depict how individuals mindfully use communication technology to enact their relationships. Such interactions also entail the exchange of new ideas on gender roles, family relations, and dominant-subordinate roles that lead to cultural change. Conclusively, technology has made it easier for OFWs and their loved ones to overcome their aversion to being in long-distance relationships and overseas employment."*

Digital communication is shown to have positive effects on couples' relationships even in the societies in which nonverbal communication is quite dominant:

#The Impact of a Video-Mediated Communication on Separated Perinatal Couples in Japan, 2018.

<https://pubmed.ncbi.nlm.nih.gov/28826337/>

Abstract: *"Japanese communication relies heavily on nonverbal cues and context. The purpose of this study was to examine the impact of video-mediated communication (VMC) on communication satisfaction and marital relationships in young couples separated during the perinatal period as they honor the Japanese tradition of Satogaeri Bunben. Couples were assigned to the VMC treatment group (n = 14) or control group (n = 13). A mixed-methods approach to data collection and analysis was used. Longitudinal quantitative analysis from the Primary Communication Inventory and Intimate Bond Measure revealed significant differences between the Husband groups. Primary Communication Inventory and Intimate Bond Measure were strongly correlated regardless of group. Qualitative analysis of participant diaries revealed the addition of visual cues helped create a sense of "virtual co-presence," which was both positive and negative. In conclusion, VMC appears to improve communication in the separated Japanese perinatal couples, especially through the addition of visual cues provided with VMC."*

10. Pandemic: unique global situation that forced a majority of the world to use digital communication almost exclusively for a prolonged period of time

The currently ongoing pandemic is obviously an extreme example for a situation where face to face communication is not possible or only in very limited ways and thus deserves its own section in our research.

NOTE: We intend to expand this research in relation to D4.1 as more research is conducted and results are published on this topic.

The psychological impact of quarantine and how to reduce it: rapid review of the evidence, 2020.

[https://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(20\)30460-8/fulltext](https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(20)30460-8/fulltext)

Abstract: *"The December, 2019 coronavirus disease outbreak has seen many countries ask people who have potentially come into contact with the infection to isolate themselves at home or in a dedicated quarantine facility. Decisions on how to apply quarantine should be based on the best available evidence. We did a Review of the psychological impact of quarantine using three electronic databases. Of 3166 papers found, 24 are included in this Review. Most reviewed studies reported negative psychological effects including post-traumatic stress symptoms, confusion, and anger. Stressors included longer quarantine duration, infection fears, frustration, boredom, inadequate supplies, inadequate information, financial loss, and stigma. Some researchers have suggested long-lasting effects. In situations where quarantine is deemed necessary, officials should quarantine individuals for no longer than required, provide clear rationale for quarantine and information about protocols, and ensure sufficient supplies are provided. Appeals to altruism by reminding the public about the benefits of quarantine to wider society can be favourable. "*

Quote: *"The ability to communicate with one's family and friends is also essential. Particularly, social media could play an important part in communication with those far away, allowing*

people who are quarantined to update their loved ones about their situation and reassure them that they are well. Therefore, providing those quarantined with mobile phones, cords and outlets for charging devices, and robust WiFi networks with internet access to allow them to communicate directly with loved ones could reduce feelings of isolation, stress, and panic.² "

11. How does this affect people personally and as groups? Is social resilience an overarching value of human society?

12. Do social bonds adapt to the means that are available?

The Interactive Evolution of Human Communication Systems

https://pubmed.ncbi.nlm.nih.gov/21564217/?from_term=%22evolution+of+human+communication%22&from_sort=pubdate&from_size=100&from_pos=6

NOTE: More research is necessary and planned from the consortium in relation to D4.1 on this topic.