与机器交流：人机传播领域的未来轨迹

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摘　要　机器行为者(machine actor)融入日常生活的现象不仅模糊了人机之间的界限,更带来了机遇和挑战。在此背景下,人机传播研究立足前沿,探索新兴的人机互动现象。这个由机器驱动的时代正在快速发展,本研究展望未来,讨论人机传播领域如何继续发展和扩展其研究范式。具体而言,本研究深入探讨人机传播的理论基础和方法论,考量以社会临场感和信任为中心的两个研究前沿,从不同角度探讨人机传播的重要意义并对人机传播未来的研究提出方向。

关键词　人机传播;机器人;人工智能;社会临场感;信任

DOI　10.26599/GJMS.2024.9330006

如果不直接反映人类行为,机器还能代表什么? 21 世纪初和 20 世纪末描绘了一个机器参与并扩展人类传播的时代图景。如今,这幅图景上留下了人工智能充满希望又令人生畏的剪影(Etzrodt & Engesser, 2019)。在十年前,机器像人类一样说话、创作艺术作品或是自主设计其他机器只存在于科幻小说中,或被态度乐观的科技杂志作为标题。然而,ChatGPT 等大语言模型和 Midjourney 等图像生成器这一类生成式人工智能的飞跃发展打破了这些界限。机器不仅提供服务或者承担中介功能,更扮演交流者和对话者的角色。无论是聊天机器人、社交机器人,还是满足个人化需求的"智能"设备,都能与人发展关系并以类人的方式进行交流。

人机传播(human-machine communication,简称 HMC)的出现,给人类与技术的互动方式带来了深刻的转变。人机传播指的是"人类和机器使用信息创造和参与社会现实的协作过程"(Edwards et al., 2022, p. 517),"这些数字交流者包括具身机器、虚拟代理、人工智能代理(例如口语对话系统)以及在真实、虚拟或者技术增强的环境中被技术增强的人"(Edwards & Edwards, 2017,

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p. 487)。随着人类不断将机器角色卷入日常生活,人机之间的界限变得越来越模糊,这为我们探索社会互动、协作式问题解决和决策都带来了机遇和挑战。人机传播的潜在收益不可估量,而我们对其可能的积极和消极影响的认知才刚刚起步(Prahl & Edwards, 2023)。

通过重新将机器概念化为对话者,人机传播挑战了将机器仅仅视为工具的传统观念(Spence, 2019; Fortunati & Edwards, 2020)。因此,它通过更多样化的理论、方法和对传播的重新定义扩展了视野,从而引领对这一互动新时代的探索(Fortunati & Edwards, 2021; Etzrodt et al., 2022)。

我们将深入探讨人机传播中的动向变化。在下文中,我们简要介绍该领域的理论和研究现状,并讨论未来的发展方向。首先,我们将详细描述人机传播的基础理论和方法论,以及面临的挑战,并围绕两个重要研究前沿——社会临场感和信任来详细展开;之后,我们从不同角度讨论人机传播的重要意义,并在每一节中提出人机传播的未来发展方向。

一、人机传播的起源

人机传播的研究历史悠久,并广布各个领域(Suchman, 2007)。作为一个正式的研究领域,人机传播可以追溯到 2010 年前后(Dehnert, 2023),产生于传播学科和相关学科的子领域(Richards et al., 2022)。正如 Guzman(2018)所言,"人机传播作为一个研究领域,并不与传播学科中的人类—计算机交互(human-computer interaction,简称 HCI)、人类—机器人交互(human-robot interaction)或人类—人工智能交互(human-artificial intelligence interaction)构成竞争,而是将他们包含其中。人机传播包含了人们与技术进行传播的各种方式"(p. 7)。在此之前,传播科学和研究的重点主要是人类如何将技术视为一种工具,并使用它进行互动,即计算机中介传播(computer-mediated communication,以下简称 CMC;Westerman et al., 2020),这个领域主要关注技术如何成为传播渠道,而对作为传播者的技术关注较少[①]。

人类与机器对话者之间首次基于文本的传播可追溯到 20 世纪 60 年代,Joseph Weizenbaum 开发了 ELIZA(Gunkel, 2012),它能利用简单的模式匹配技术模拟对话。ELIZA 是人工智能领域的一项突破,展示了机器模仿人类对话进行文本交流的潜力。互联网的进步和算力的提升使得聊天机器人和虚拟助手在 21 世纪初大量涌现,而微软的 Clippy、苹果的 Siri 等代理的出现也为现代对话代理的发展铺平了道路。

与此同时,这项技术也被应用于具身的社交机器人(embodied social robots)。这些社交机器人旨在与人类进行自然互动,并且用途广泛,可以提供

陪伴、教育与医疗保健。而具身社交机器人（例如 Pepper、Nao、Sophia）也能与人自然互动，且具备提供陪伴（Abendschein et al.，2022；Merrill et al.，2022；Dang & Liu，2023）、教育（Edwards et al.，2018；Abendschein et al.，2021）和医疗保健的潜力（Blindheim et al.，2023；Kim et al.，2023b，2023c）。学者试图训练这些机器人识别情绪、进行对话和学习新技能。对社交机器人和人工智能系统的探索催生了新的传播理论——人际互动脚本理论（详见 Spence et al.，2014；Edwards et al.，2016b，2019；Craig & Edwards，2021）与“计算机作为社会行动者”范式（computer as social actor paradigm，以下简称 CASA）的扩展和改良（Gambino et al.，2020；Lombard & Xu，2021；van der Goot & Etzrodt，2023）。

作为一个重要的跨学科研究领域（Fortunati & Edwards，2021），人机传播使得不同领域的学者成功开展合作（Richards et al.，2022），并从不同的方法中获益（例如 Dehnert，2023），传播学期刊中有关人机传播的研究大量增加，研究内容日益丰富，也印证了这一点。例如，从 2020 年到 2021 年，已发表的人机传播论文增长了 119%（详见 Richards et al.，2022）。人机传播融入到了传播学的多个子领域中，如将机器视为人际伙伴（Ling & Björling，2020；Lutz & Tamò-Larrieux，2020；Rodríguez-Hidalgo，2020；Merrill et al.，2022；Kim et al.，2023a）、传播者（Etzrodt，2021，2022；Etzrodt & Engesser，2021）、教学资源（Edwards et al.，2016a，2021）和健康顾问（Kim et al.，2023b）。此外，聊天机器人也被用于各种用途（Banks & Van Ouytsel，2020；Beattie et al.，2020），学者们考虑了人机传播对新闻业（Lewis et al.，2019；Johanssen & Wang，2021；Kim et al.，2022c）、团队工作与自动化（Piercy & Gist-Mackey，2021；Utz et al.，2021；Stephens et al.，2023）以及身份认同问题（Davis & Stanovsek，2021；Dehnert & Leach，2021；Liu，2021）的影响。

二、人机传播的概念基础

人机传播理论的出现为传统传播科学和研究带来了“范式转变”，它的出现回应了技术创新对 CMC 这一公认框架的挑战（例如，Gunkel，2020）。人机传播专门将现代代理技术（包括人工智能、社交机器人、数字助手或物联网设备）作为交流者和对话伙伴，强调了人机交流中的社会互动和关系。因此，这些研究有意使用“机器”一词而非“技术”，是为了唤起支撑该研究领域的文化、哲学和技术传统（Guzman，2020）。

人机传播对传播行为及其行动者重新概念化以便将机器作为合法的传播

者纳入其中，这也构成了人机传播的概念基础的基石（例如，Edwards & Edwards，2017；Guzman，2018；Edwards et al.，2020；Etzrodt et al.，2022）。尽管人机传播并非经典人际传播的完美镜像（例如，Fortunati & Edwards，2020），但正如 Etzrodt 等（2022）所总结的，人机传播是人类与数字对话者之间的信息交换和阐释，对话双方都参与某种形式的意义生成、社会互动或关系建立，重要的是，Etzrodt 等（2022）指出，只要其中一方将沟通过程视为传播，双方的交流就可被归为传播，而信息交换、解释、意义生成、社会互动和关系是多层次的，在微观、中观和宏观层面都能运作和形成。

（一）人机中的意义生成

人机传播强调与机器进行传播的人类、文化和实践（例如，Natale & Guzman，2022），其中，赋予机器行为体属性（actorness）——我们如何、何时以及为何在交流中将机器定义为代理或行动者，以及相关的规范性讨论，在理论框架中占据着核心地位。在这种情况下，人际传播理论（human-human communication）往往成为探索机器传播能动性的基础框架。此外，人机比较经常转而探讨“这对人类而言意味着什么”（Spence，2019，p. 286）。简而言之，人机传播主要依赖于共同建构主义视角（co-constructivist perspective），将人类和机器都视为社会建构、协商和人类归因的产物（Rammert & Schulz-Schaeffer，2002；Edwards et al.，2020）。因此，尽管在特定情况下需要区分人机传播和人际传播，但共同建构的方法依旧质疑了原有的传播学框架，即不同类型的传播主体是否需要作出区分。因此，未来的研究必须明确人机传播和人际传播的概念区别。在这一问题上，下文将简要阐述对此至关重要的且具有影响力的两种范式。

（二）等同还是唤起，这是一个问题

CASA 是该领域最有影响力的“缩写词”，也是媒介等同范式（Media Equation paradigm）的基石，围绕 CASA 的争论始于 20 世纪 90 年代，认为人机传播等同于人际传播（Nass et al.，1993，1994）。在相当长的一段时期内，关于 CASA 的学术讨论很大程度局限于这一特定范式（Fortunati & Edwards，2021）。然而，这一框架面临了越来越多的审视，除了可复制问题，当人际关系理论被应用于人机传播时，也被发现两者之间存在显著差异（van der Goot & Etzrodt，2023）。随着学者们在不过分脱离该范式的情况下对其进行调整或细化，文献里出现了一种微妙的重新诠释的趋势。

为了解决这个问题，van der Goot 和 Etzrodt（2023）近期在 CASA 经典解读的基础上引入了新的视角：媒介唤起范式（Media Evocation paradigm），它借

鉴了 Sherry Turkle 关于唤醒对象(evocative objects)的奠基性工作。与媒介等同范式相似，媒介唤起范式也旨在解释人类与机器进行社会互动的缘由。但与之不同的是，媒介唤起范式深入探讨了与机器互动的意识(mindful)层面，将机器视为深入探索和协商新本体论范畴的催化剂，提出了关于人类身份、情感和认知的本质问题(Fortunati & Edwards，2020)。虽然这一范式尚未像媒体等同那样受到学术界的广泛关注，但已悄然对人机传播的知识领域产生了相当大的影响。

正如 van der Goot 和 Etzrodt(2023)所指出的，范式的选择在三个关键领域起着至关重要的决定性作用：(1) 它影响着哪些研究问题被认为是相关的；(2) 它指导着方法论的选择；(3) 它影响着研究中可获得的结论。在这方面，我们鼓励人机传播学者在不同的传播环境中测试和检验这一新框架，并对这两个范式进行更详细的阐释以增强对人机传播的理解。

(三) 微观、中观和宏观层面

人机传播理论探索的最后一个方面是增加社会层面的考量。最初，人机传播的理论探索主要集中在微观现象，强调社会互动和人际关系(Richards et al.，2022)。最近，探索逐渐往宏观方向转变，人机传播开始涉及更多文化因素(Natale & Guzman，2022)和更广泛的语境因素(Hepp et al.，2022，2023)。然而，学者们对包括群体和制度动态学(institutional dynamics)在内的中观层面依旧缺乏关注。尽管一些学者已有所涉及(例如，Etzrodt，2022；Etzrodt & Engesser，2021)，但不同机器类型如何在机构层面运转，产生了哪些影响，对这类问题的探索依旧是不足的。事实上，这不仅是学术上的疏忽，更是一个亟须关注的关键空白。随着企业逐渐应用代理技术并将其商业化，这些技术越来越紧密地嵌入我们的日常生活中，中观层面的研究将在权力动力学、伦理、治理问题上发挥重要作用。因此，人机传播研究中亟须融入这些社会层面。

三、人机传播的方法论

虽然人机传播在理论和方法上是一个开放的领域，但与其不断增长的理论创新潜力相比，方法论的发展略显缓慢。鉴于该领域仍处于早期阶段，能够清晰描绘当前发展前景的元分析或综述并不多见。在此背景下，本研究简要借鉴了三项基础研究的成果：Richards 等(2022)对过去十年内人机传播学术趋势的元研究，Makady 和 Liu(2022)对过去十一年实证研究的元研究，以及 Greussing 等(2022)对人机传播实验面临的方法论挑战的概述讨论。人机传播领域正处于巨大潜力尚未开发的临界点，这不仅体现在方法的多样化上，还在于分析框

架的完善，从而对数据作出更丰富的解释。挖掘这一潜力将推动该领域向前发展，并对日益复杂的人机传播产生丰富理解。

（一）研究方法

Richards等(2022)的研究结果显示，人机传播实证研究的方法多样性非常有限：以定量方法为主流，辅以少量定性或混合方法研究。正如Makady和Liu(2022)的研究所证实的，大约三分之二的实证研究都采取了与媒介等同范式相似的方法(van der Goot & Etzrodt，2023)，都依赖于(主要基于实验室的)实验。尽管其余三分之一的研究采用了各种方法(例如修辞或话语分析、案例研究、内容分析、调查、访谈)，但混合方法、生理学调查和观察研究依旧较少。方法视野相对受限且依赖标准化的程序，这与人机传播多样化和不断发展的研究图景形成了鲜明对比。

此外，当务之急是找到实施纵向研究的方法，因为这种方法会给人机传播领域带来特定的复杂问题，例如在较长时间内实现一致的交互能力或处理大量生成的用户数据(Greussing et al.，2022)。该领域要想继续发展，就必须扩大方法的多样性并着眼于长远。在这方面，鉴于其兼收并蓄的研究对象和知识的开放性，人机传播为探索和发展新颖的方法、组合和范式提供了理想的环境。

（二）分析方法

然而，需要关注的不仅仅是研究设计，还有数据分析。迄今为止的元研究在很大程度上忽视了数据分析的复杂性。值得注意的是，直接应用人际关系理论会让数据表现出明显的偏斜性(skewness)。此外，组与组之间的方差可能存在显著差异，尤其是在比较人机组别差异时，因此，传统的分析技术，如中心趋势分析或方差分析，可能不适合用来产生稳定而有意义的见解(Rousselet et al.，2017)。展望未来，人机传播研究必须创新数据收集方法并批判性地重新评估分析方法，这就需要制定更稳健且标准的数据审查程序，从而得出可靠和有价值的结论(Etzrodt，2022)。

四、关键研究前沿：人机传播中的社会临场感与信任

（一）人机中的社会临场感

人机传播与其他传播领域的不同之处在于交互伙伴是机器而非人类。在这方面，社会临场感(social presence)在人机传播中起着举足轻重的作用。Lee(2004)将社会临场感定义为“一种心理状态，在这种状态下，虚拟的社会行动者

被体验为实际的社会行动者”(Lee，2004，p.45)。用户会产生这种倾向是因为他们把机器感知为一种社会性存在(social being)而不是物体(object；Lee，2004)。研究强调了其对用户态度和行为结果的影响，如对技术的信任、接受和顺从(详见 Oh et al.，2018 的元分析)。社会临场感的影响已经在不同人机传播环境中得到充分证明，如教育(Edwards et al.，2021；Kim et al.，2021，2022a，2022b)、健康(Kim et al.，2023c)和娱乐与关系(Kim et al.，2023a)。越来越多机器开始具备自然、直观和拟人化特征，这也强调了临场感日益增长的重要性。

然而，社会临场感在人机传播背景下的概念内涵需要被进一步明晰。尽管自社会临场感概念提出以后(Short et al.，1976)，学者为丰富这一概念的多面性投入了大量精力(Biocca et al.，2003；Lee，2004)，但依旧没有确立牢固的定义或实现普遍的概念化。一些学者依赖于人与人之间的定义(Short et al.，1976)，而另一些学者在更广泛的基础上对其概念化，延伸到了人类之外的各种代理类型(Biocca et al.，2003；Lee，2004)。与此同时，具备一致性的测量方法依旧没有出现，无法与概念化相互匹配，使得研究结果大相径庭。为了深化社会临场感在人机传播中的作用，学者们必须在概念上和操作上给出综合性的定义。

在人机传播的研究中，社会临场感的多面性未被充分发掘。虽然学者们已经界定了社会临场感的几个维度，如共同在场(copresence)和心理卷入(psychological involvement；Biocca et al.，2003)，但对于不同类型的机器代理(例如机器人、聊天机器人、语音助手)，相关的实证研究依旧不足。随着该领域的发展，我们鼓励人机传播的学者解决这一问题。

虽然社会临场感通常被视为一种积极体验，但另一个基本问题需要解决，即在人机传播中需要多大程度唤起或培养社会临场感。恐怖谷效应(uncanny valley)表明，如果机器代理与人类过于相似，用户可能会对机器产生负面情绪反应 (Kätsyri et al.，2015)。将这一效应与社会临场感联系起来，我们应该在多大程度上培养或唤起社会临场感？在广泛的层面上，人们已经讨论了机器类人的伦理问题(Hancock & Bailenson，2021)。然而，很少有研究触及社会临场感在人机传播语境中的潜在危险。虽然社会临场感可以带来与真人对话形似的交互体验，但也可能导致破坏性后果。当用户持续强烈地从人工智能伴侣身上感受到社交临场感时，他们对机器的依赖可能大于人类，对人际关系产生不切实际的观点，并远离自然的人际交往。由于技术进步将持续唤起更多的社会临场感，人机传播研究需要考虑如何消除社会临场感的潜在危险。

(二) 人机信任

人机之间的信任关系历史悠久。追溯到 18 世纪，著名的勒德派(Luddites)

曾把机器视为威胁，通过积极销毁机器来表达一种极度的不信任（Jones，2013）。到了 20 世纪中期，艾伦·图灵（Alan Turing）和 Joseph Weizenbaum 等重要人物也提出了机器信任的关键问题，与人类的认知和对话相关（Weizenbaum，1966；Turing，1950）。如今，由于技术进步和产业对自动化的快速整合，对机器的信任仍然至关重要，（各行各业）都希望培养员工与机器之间的信任（Moritz & Smaje，2022）。尽管人机信任立足于大量的研究，但依旧面临着挑战。

我们鼓励人机传播的学者在概念和操作上建立对这一概念更扎实的理解以回应这一挑战。信任在各种理论模型中都有描述，从对人类同伴的信任到对动物、虚拟代理和社交机器人的信任（Sundar，2020；Banks et al.，2021）。这些模型共同包含了几乎数不胜数的子概念。因此，不同研究对信任的操作化也大相径庭，既有简单的“Godspeed 问卷”（Bartneck et al.，2009），也有精心设计的多维度测量（Weidmüller，2022）。此外，对机器的“不信任”也使讨论变得更加复杂。一方面，研究开始关心“过度信任”，即对自动化的过度依赖（Wischnewski et al.，2023），而在另一方面，“算法厌恶”（algorithm aversion）等现象则反映了“信任不足”或“不信任”等问题（Parasuraman & Riley，1997）。未来的研究需要对信任进行更细致的概念化和操作化，从而产生更系统的理解。

与上述问题相关的另一个挑战是学者之间对信任的理解相差甚远。一些研究将信任概念化为一种心理状态或态度，这种方法在人机传播研究中很常见，因为所研究的技术可能是最前沿的，或用于私人家庭环境，因此无法进行实验室研究（例如家庭助理；Lutz & Tamò-Larrieux，2020；Weidmüller，2022；Rosenthal-von der Pütten & Bock，2023）。其他研究则将信任概念化为一种行为，这是研究人类—自动化信任的常见视角（Dzindolet et al.，2003；Huang et al.，2021），也被用于人机传播中的研究中（Prahl & Van Swol，2021）。前一种视角使用调查工具和自我报告来测量信任，而后一种视角则要求参与者采取行动并对行为进行衡量。虽然不同的视角提供了不同的切入角度，但这会使不同研究之间缺乏可比性。因此，随着该领域的发展，学者们应该仔细考虑如何处理信任这一概念来形成系统的理解。

第三个挑战是如何将信任概念与可信度等相关概念区分开来。例如，信任和可信度经常被用作同义词，实际上前者描述的是信息接收者的心理状态（或行为），而后者则指向信息发送者（Weidmüller，2022）。这种模糊性（ambiguity）给综合现有文献的研究结果带来了挑战。这个例子所展示的挑战与信任的概念化有关，因此，我们建议学者进一步探索信任的概念化边界。

最后同样重要的一点，确定人类对机器信任的最佳水平对于人机传播研究至关重要。信任决定了人们与特定机器的交互方式（Li et al.，2008），并影响着

人们对特定机器的采用(Gefen et al.，2003)。从设计者的角度来看，在人机之间引导最大程度的信任是合理的。然而，从道德和社会的角度来看，这可能产生一种不切实际的自动化偏见(Cohen et al.，1998)，诱发了过度依赖机器的潜在危害(Bussone et al.，2015)。因此，尽管机器有诸多益处(Abbas et al.，2018)，但人机传播的学者应该考虑各种观点，并研究最有效的人机信任水平。

五、人机传播未来研究的启示

人机传播学术研究不断普及，而自动化也在个人和职业领域得到广泛应用。这种增长使行业专业人士、企业和政策制定者能够更加自信地在不断发展的传播自动化“迷宫”中前行。在此背景下，我们将深入探讨人机传播研究在实践、行业和社会中产生的连锁反应，并讨论其对人机传播未来的影响。

(一) 对实践和行业的影响

在不断发展的人机传播图景中，与机器的互动正变得更加对话化。然而，如果机器不能达到某些标准，无论是交流质量本身、拟人化、隐私问题、情境使用失当(例如共情驱动的角色)，还是其他伦理问题，都有可能导致人们不愿意与机器互动。此外，我们也需要警惕，出现“恐怖谷”效应和过度信任机器的可能性也在不断增加。这些都表明需要精心的设计和细致的监管来驾驭人机传播未来复杂道路的迫切需求，这对从业人员和相关行业部门的影响都是深远的。通过目前的观察，我们可以窥见未来人机合作的深化、挑战以及人机传播研究的空间，从而为新兴技术催生的行业和从业者作出贡献。

当机器在工作场所大显身手时，考虑到如今的机器比过去更具对话性，专业人员必须重新安排自己的日常工作。尽管取得了这一进步，但一个问题经常出现：个人会根据自己的独特优势制定工作流(workflow)，强制引入自动化会扰乱这些流程，可能导致异议、士气低落，甚至对技术的排斥(Olakotan & Mohd Yusof，2021)。在这一领域，随人机传播的学者探索个人如何塑造技术和机器，从而与个人的工作流相互配合，我们认为未来的研究将进一步偏离技术决定论。

人机传播的浪潮将预示着某些行业的衰落，同时催生新的行业。随着生成式人工智能工具的出现，编辑、文案和设计等传统传播角色可能会被速度更快、成本效益更高的机器传播者所取代。然而，由人工智能驱动的人类前景并非完全黯淡，因为人工智能容易产生虚假信息，这就突出了“真实性产业”在核查可信度上的作用(Alloway & Weisenthal，2023)。这一领域突出了人机协作的必要性，从而预示着一个人机共生的未来。对于人机传播学者来说，方向显而易

见，就是深入研究人机交互中的信任和可信度。虽然我们之前关于信任的讨论为行业领导者提供了一个起点，但我们仍然迫切需要广泛的研究。

当我们进一步展望人机传播研究的未来时，亟须确立人类与机器之间的角色差异。人们认为机器是管理客观数据的专家（Prahl & Van Swol，2021），而人类则更擅长复杂情感和创造力（Takayama et al.，2008），对这一问题的探索将在未来的人机传播研究中占据一席之地。在特定的传播任务中，机器可能比人类更胜一筹，但挑战在于设计出能在个性化定制、任务能力和交流的细微差别之间取得平衡的机器，而人机传播研究将为此类创新带来启示。

（二）对社会的影响

随着对话型社交机器融入我们的日常生活，它们已经开始重塑以往不被质疑的世界观和道德观。近年来，这些发展显然引发了社会反应，使我们有能力重新定义和扩展传播的传统范畴，加深我们对机器、错综复杂的世界和人性本身的理解。

最重要的转变之一发生在社会性领域以及我们对社会机器的看法上，社会临场感和信任也强调了这一点。随着机器很快就能辨别我们的个性和信仰，并代表我们进行交流，也出现了潜在的人际关系减少、新的数字礼仪和规范的诞生等情况。随着我们迈向这个部分由机器交流者驱动的时代，人们的担忧也在加剧，因此有必要进行全面的探索。未来的人机传播将继续探索人机以及人际之间的关系重塑，确保机器不会远离我们人类的本质。

与此同时，人们越来越担忧机器可能习得的固有偏见。由于偏见是人类由来已久的缺陷，从人类数据中获取洞察的机器将不可避免地习得并复制人类偏见。这种复杂性导致了有关偏见识别、消除偏见所需的资源分配、开发人员可能承担的道德义务等迫切问题（Sargent，2021），因此，未来的研究应探讨公平在人机交互中的发展和融入问题。

六、结语

在快速发展的人机传播领域，我们正在见证一个以人机合作为特征的变革时代，它重塑了既定的规范、期望和道德考量。人机传播领域一直在探索这种转变，即从仅仅将机器视为工具转变为将其视为塑造我们社会现实的数字对话者。通过这一视角，我们探讨了理论基础和方法论，也回顾了社会临场感和信任这两个重要研究前沿，以及更广泛的影响。

随着我们迈向由机器对话驱动的未来，挑战和机遇都在成倍增加，并涉及教育、医疗保健、法律、娱乐等多个领域，还包括新兴技术催生的新产业。虽然

机器提供了效率和高阶能力，但我们也需要解决过度依赖机器、人与人之间的联系减少等潜在问题。当务之急是引导和优化人机之间的协同作用，而人机传播将在这一过程中发挥着关键作用。

在这个机器驱动的传播时代，我们所有人都肩负责任。学者们有责任提供知识，促进人际传播的积极影响并降低危害。人机传播是一个不断变化的领域，能为新视角和新方法提供绝佳的机会，而这一领域的专业知识整合自多个学科，也能为相关的实际难题提供可靠的研究基础。从业人员和行业领导者应当以负责任的态度对待技术的发展，在提高效率的同时尊重错综复杂的人性和伦理。

通过持续不断的人机传播研究，我们能为人类智慧和机器能力的交融创新铺平道路。未来的社会不仅拥有先进的技术，更是一个机器负责地、包容地与人类付出互相补充的社会。展望未来，社会与技术融合带来了挑战和机遇，而人机融合正召唤着学者们去进行深入的探索。

注释

① 关于人机传播作为一个传播子领域的详细历史，详见 Guzman(2018)所编书籍的引言，以及 Spence(2019)在 *Computers in Human Behavior* 特刊中的引言。有关人机传播的模式和历史，请参阅 Etzrodt 等(2022)为《新闻学》(*Publizistik*)特刊撰写的引言。

(翻译：清华大学新闻与传播学院　刘力铭)

Communicating with Machines: Future Trajectories in the Field of Human-Machine Communication

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Abstract　Integrating machine actors into daily life blurs the line between humans and machines, presenting opportunities and challenges. Within this context, the field of human-machine communication (HMC) stands at the forefront, poised to explore this emerging phenomenon of human-machine interaction. As we look into the future of this rapidly evolving era driven by machines, this essay discusses how the field of HMC can continue to grow and expand its research paradigm.

Specifically, the essay delves into the theoretical foundations and methodological approaches of HMC, addresses two prominent research frontiers centered on social presence and trust, and then examines critical implications of HMC from various perspectives. Throughout the essay, it offers insights into future directions for HMC research.

Key Words HMC; Human-Machine Communication; Robots; AI; Social Presence; Trust

What are machines if not a reflection of human endeavor? The digital landscape of the 1990s and early 2000s painted a picture of an era where machines became participants in expanding human communication. Today, the horizon is painted with the promising and daunting silhouettes of artificial intelligence (AI) (Etzrodt & Engesser, 2019). Just one decade ago, machines speaking like humans, creating artwork, or autonomously designing other machines was only a plot in a sci-fi novel or the optimistic headline of a tech magazine. Yet, recent strides in Generative AI, such as LLMs (e. g., ChatGPT) and image generators (e. g., Midjourney), have shattered these boundaries. The machinery does not simply provide or mediate; it takes the role of communicator and interlocutor. Be it chatbots, social robots, or the myriad of "smart" devices personalized to our every need, machines designed to form relationships and communicate with humans in natural (human-like) ways.

This emergence of human-machine communication (HMC) has brought about a profound shift in how we interact with technology. HMC refers to the "collaborative process in which humans and machines use messages to create and participate in social reality" (Edwards et al., 2022, p. 517) and "involves communication with digital interlocutors including embodied machine communicators, virtual and artificially intelligent agents (e. g., spoken dialogue systems), and technologically augmented persons, either in real or virtual and augmented environments" (Edwards & Edwards, 2017, p. 487). As we continue integrating machine actors into our daily lives, the line between humans and machines becomes increasingly blurred. This presents opportunities and challenges as we navigate a new frontier of social interaction, collaborative problem-solving and decision-making. The potential

benefits of HMC are vast, and we are only beginning to understand what is possible, both positively and negatively (Prahl & Edwards, 2023).

By reconceptualizing machines as interlocutors in their own right, HMC challenges the traditional conception of them as mere tools (Spence, 2019; Fortunati & Edwards, 2020). Therefore, it opens the perspective through a more diverse set of theories, methods, and the reconceptualization of communication, enabling the field of HMC to lead the exploration of this new era of interaction (Fortunati & Edwards, 2021; Etzrodt et al., 2022).

This paper delves into the dynamic realm of HMC. In the following sections, we provide a brief background of the field's current state in theory and research, complemented by a discussion of future directions. In detail, we will first portray the foundational theoretical and methodological approaches to HMC and its challenges. We consolidate this portrait by exploring two prominent research frontiers in HMC: social presence and trust. Then, we discuss critical implications of HMC from various angles. In each section, we suggest future directions for HMC.

Origins of Human-Machine Communication

The study of human and machine interactions has been around for many years and can be found in various fields (Suchman, 2007). HMC, as a formal field of study, can be traced to the late 2010s (Dehnert, 2023) and has emerged from various subfields within communication and related disciplines (Richards et al., 2022). As Guzman (2018) argued, "Human-Machine Communication as an area of study is not a competitor to HCI, HRI, or HAI within communication or related research; it subsumes them. HMC can be thought of as an umbrella encompassing the many approaches to people's communication with various technologies" (p. 7). Before this time, the focus of Communication Science/Studies has primarily been on the use of technology as a tool to enable individuals to interact, known as computer-mediated communication (CMC) (Westerman et al., 2020), which focuses on the channel of communication (mediated by technology) and not when a machine is a communicative partner. For a detailed history of the creation of HMC as a subfield, see Guzman's (2018) introduction in her edited book and Spence's (2019) introduction to a special issue of *Computers in Human Behavior*. For

a model and the history of HMC, see Etzrodt et al.'s (2022) introduction to the special issue in *Publizistik*.

The first instance of text-based communication between humans and machine interlocutors can be traced back to the 1960s with the development of ELIZA by Joseph Weizenbaum (Gunkel, 2012). ELIZA was designed to simulate conversations using simple pattern-matching techniques. It was a breakthrough in AI, demonstrating the potential for machines to engage in text-based exchanges resembling a human conversation. The Internet and computing power advancements led to the proliferation of chatbots and virtual assistants in the early 21st century. Agents like Microsoft's Clippy and Apple's Siri paved the way for modern conversational agents.

At the same time, this technology was being applied to embodied social robots. These social robots are designed to interact with humans naturally and can be used for various purposes, such as providing companionship, education, and healthcare. Embodied social robots (e. g., Pepper, Nao, Sophia) are designed for natural interaction with humans and have the potential for companionship (Abendschein et al., 2022; Merrill et al., 2022; Dang & Liu, 2023), education (Edwards et al., 2018; Abendschein et al., 2021) and healthcare (Blindheim et al., 2023; Kim et al., 2023b, 2023c). Researchers seek to train these robots to recognize emotions, hold conversations, and learn new skills. These explorations with social robots and AI systems have led to new theories about communication—for the human-to-human interaction script theory (see Spence et al., 2014; Edwards et al., 2016b, 2019; Craig & Edwards, 2021) and extensions/modifications on the CASA paradigm (see Gambino et al., 2020; Lombard & Xu, 2021; van der Goot & Etzrodt, 2023).

HMC is an interdisciplinary and vital field of research (Fortunati & Edwards, 2021), with different areas that can work together successfully (Richards et al., 2022) benefiting from diverse approaches (e. g., Dehnert, 2023). This success is confirmed by the massive growth and diversity of research on HMC contexts in communication journals. For example, from 2020 to 2021, published research articles examining HMC grew by 119% (see Richards et al., 2022). HMC has incorporated diverse subfields of communication, such as the investigation of machine actors as interpersonal partners (Ling & Björling, 2020; Lutz & Tamò-Larrieux, 2020; Rodríguez-

Hidalgo, 2020; Merrill et al., 2022; Kim et al., 2023a) or communicators (Etzrodt, 2021, 2022; Etzrodt & Engesser, 2021), instructional resources (Edwards et al., 2016a, 2021), and health advisors (Kim et al., 2023b). Additionally, chatbots have been explored in various capacities (Banks & Van Ouytsel, 2020; Beattie et al., 2020). Scholars have considered the implications for HMC in journalism (Lewis et al., 2019; Johanssen & Wang, 2021; Kim et al., 2022c), work teams and automation (Piercy & Gist-Mackey, 2021; Utz et al., 2021; Stephens et al., 2023), and issues of identity (Davis & Stanovsek, 2021; Dehnert & Leach, 2021; Liu, 2021).

Conceptual Foundations in HMC

The advent of HMC theory could be viewed as a "paradigm shift" within conventional communication science/studies, which emerged in response to technological innovations that challenged the established frameworks of CMC (e. g., Gunkel, 2020). Due to specifically addressing modern agent technologies, including AI, social robots, digital assistants, or Internet-of-Things devices, as communicators and conversational partners, HMC theories spotlight the social interaction and relationship between humans and machines within communicative settings. Thereby, the intentional use of the term "machine" over "technology" serves the specific purpose of invoking the cultural, philosophical, and technological traditions that underpin the field of study (Guzman, 2020).

A cornerstone of HMC's conceptual foundation is the reconceptualization of both the definition of communication and its constituent actors to allow for the incorporation of machines as legitimate communicators (e. g., Edwards & Edwards, 2017; Guzman, 2018; Edwards et al., 2020; Etzrodt et al. 2022), although it is acknowledged that interactions with machines may not perfectly mirror classical human-human communication (e. g., Fortunati & Edwards, 2020). As summarized by Etzrodt et al. (2022), HMC can be characterized as the exchange and interpretation of messages between a human and a digital interlocutor, where both interlocutors engage in some form of meaning-making and social interaction or relationship. Importantly, Etzrodt et al. note that it is sufficient for the communication to be classified as such, if just one of the parties involved defines it as a communicative exchange. The facets of

exchange, interpretation, meaning-making, social interaction, and relationship are multi-layered, operating and being shaped at the micro, meso, and macro levels (Etzrodt et al., 2022).

Meaning-Making in HMC

HMC places a strong emphasis on the humans engaged in communication with the machines, along with their cultures and practices (e.g., Natale & Guzman, 2022). The concept of ascribed machine-actorness—how, when, and why we define and treat machines as agents or actors in communicative settings—and the normative discussions that stem from these ascriptions occupy central roles in the theoretical framework. In this context, theories of interpersonal human-human communication (HHC) often serve as the foundational framework for exploring machine agency within the communication process. Moreover, this comparative approach frequently evolves into exploring "what it means to be human" (Spence, 2019, p. 286). In a nutshell, HMC primarily relies on a co-constructivist perspective (Rammert & Schulz-Schaeffer, 2002; Edwards et al., 2020) by considering both machinic and human actorhood as socially constructed, negotiated, or ascribed by human agents. Consequently, despite the need for distinction between HHC and HMC in specific situations, the co-constructive approach challenges the necessity for a general distinction of the conceptual framework of communication and its actors. Thus, future research must delineate clear criteria for when a conceptual distinction between HMC and HHC is warranted and superfluous. In this regard, we will briefly elaborate on two influential paradigms that have significantly shaped the discourse on this issue.

Equation or Evocation, That is the Question

CASA (Computers as/are Social Actors), which serves as a cornerstone of the Media Equation paradigm, the argument from the 1990s that HMC equates to HHC (Nass et al., 1993, 1994), stands as one of the most influential acronyms in the field of HMC. For a considerable period, scholarly discussions about CASA were largely confined to the framework of this particular paradigm (Fortunati & Edwards, 2021). However, this framework

faces increasing scrutiny today, resulting from replication issues and the discovery of notable discrepancies when applying interpersonal theories to HMC (van der Goot & Etzrodt, 2023). There has been a consistent trend in the literature towards subtle re-interpretations, as scholars adapt or nuance the paradigm without overtly breaking away from it.

To address this issue, a recent reframing by van der Goot & Etzrodt (2023) introduces a new perspective on this conventional reading of CASA: the "Media Evocation" paradigm, which draws on Sherry Turkle's foundational work on evocative objects. Like the Media Equation paradigm, the Media Evocation paradigm aims to explain why humans interact socially with machines. In contrast to the Media Equation, Media Evocation delves into the conscious aspects of interacting with machines, treating them as catalysts for deeper exploration and negotiation of new ontological categories, raising questions about human identity and the nature of emotion and cognition (Fortunati & Edwards, 2020). While this paradigm has not yet received as much overt scholarly attention as the Media Equation, it has quietly exerted a comparable influence on the intellectual terrain of HMC research.

As pointed out by van der Goot & Etzrodt (2023), the choice of paradigm serves as a crucial determinant in three key areas: (1) it influences which research questions are considered relevant; (2) it guides the selection of methodologies; and (3) it shapes the conclusions that can be drawn from the research. In this regard, HMC scholars are encouraged to test and examine this new framework in diverse HMC contexts and explicate both perspectives to grow and strengthen our understanding of HMC.

The Micro-, Meso-, and Macro-Levels

The last aspect of theoretical inquiry in HMC is the need to increase engagement with societal levels. Initially, theoretical explorations in HMC primarily centered on micro-level phenomena, emphasizing social interactions and interpersonal relationships (see Richards et al., 2022). Recently, we are witnessing a shift toward incorporating macro-level dimensions, particularly concerning cultural factors (e. g., Natale & Guzman, 2022) and broader contextual elements (Hepp et al., 2022, 2023). However, the meso level, which encompasses group and institutional dynamics, has not yet received as much scholarly attention in HMC. Although some scholars consider the meso

level in their research (e. g. , Etzrodt, 2022; Etzrodt & Engesser, 2021), a dearth of research explicitly addresses institutional processes and influences in HMC across all machine types. In fact, this is not just an academic oversight; it is a critical gap that demands urgent attention. As businesses increasingly adopt and commercialize agent technologies and these technologies are embedded more intensely into our daily social fabric, the meso level will become particularly pivotal for power dynamics, ethics, and governance questions. In this regard, there is a strong need to engage with societal levels in HMC research.

Methodological Approaches in HMC

While HMC understands itself as a theoretically and methodologically open-minded field, the advancement in methodological approaches appears to be developing at a slightly slower pace compared to the growing potential of theoretical innovations. Given that the field is still in its early stages, comprehensive meta-analyses or reviews that could offer a clear picture of the current HMC landscape are rare. Against this backdrop, the following brief reflection draws upon the findings of three foundational studies: Richards et al. 's (2022) meta-study of HMC scholarship trends over the past 10 years, Makady & Liu's (2022) meta-study of empirical studies over the past 11 years, and Greussing et al. 's (2022) overview discussion of methodological challenges to HMC experiments. The realm of HMC stands at the threshold of vast untapped potential, not only in the diversification of methodologies but also in the refinement of analytical frameworks capable of decoding the data these methods produce. Tapping into this potential will drive the field forward and enrich our understanding of increasingly complex human-machine interactions.

Methods

According to the results of Richards et al. (2022), HMC's empirical research exhibits only limited diversity: It is heavily leaning toward quantitative data collection methodologies, supplemented by a modest fraction of qualitative or mixed-method studies. As confirmed by Makady & Liu (2022), roughly two-thirds of empirical studies resemble the approach of the Media Equation paradigm (see van der Goot & Etzrodt, 2023) by relying on

(mainly lab-based) experiments. Although the remaining third employs various methods (e.g., rhetorical or discourse analyses, case studies, content analyses, surveys, interviews), mixed methods, physiological surveys, and observational studies are relatively uncommon. This constrained methodological scope and reliance on standardized procedures stand in stark contrast to HMC's diverse and evolving research landscape.

Additionally, it is imperative to find ways to engage in longitudinal research as this approach poses specific complications in the HMC domain, such as achieving consistent interactive capabilities over extended periods or handling massively generated user data (see Greussing et al., 2022). If the field aims to continue to evolve, an expansion of methodological diversity and a long-term perspective is vital. In this regard, HMC provides an ideal setting for exploring and developing novel methodological approaches, combinations, and paradigms, given its eclectic research objects and intellectual openness.

Analysis

Yet, it is not just the research design that requires attention; how we approach data analysis in HMC also calls for a reevaluation. To date, meta-studies have largely overlooked the intricacies of data analyses. This oversight is notable given that the data often exhibit pronounced skewness due to the direct application of interpersonal theories. Furthermore, the variance between groups can be significantly different, especially when comparing human and machine interactions. As a result, conventional analytical techniques, such as the analysis of central tendencies or variance analyses like AN(C)OVA, may not be appropriate for generating stable and meaningful insights (Rousselet et al., 2017). Moving forward, HMC research must innovate data collection methods and critically reassess how the data are analyzed. This entails the development of more robust standard procedures for data scrutiny to yield reliable and valuable findings (e.g., Etzrodt, 2022).

Key Research Frontiers: Navigating Social Presence and Trust in HMC

Social Presence of Machines

What distinguishes HMC from other communication areas is the nature of

the interaction partner, machines instead of humans. In that regard, social presence plays a pivotal role in HMC. Lee (2004) defines social presence as "a psychological state in which virtual social actors are experienced as actual social actors" (Lee, 2004, p. 45). This tendency occurs because users perceive machines as a kind of social being rather than objects (Lee, 2004). Research highlights its influential role in users' attitudinal and behavioral outcomes, such as trust in, acceptance of, and conformity to technologies (see a meta-analysis by Oh et al., 2018). In particular, the implications of social presence have been well documented in diverse HMC contexts, such as education (e. g., Edwards et al., 2021; Kim et al., 2021, 2022a, 2022b), health (e. g., Kim et al., 2023c), and entertainment/relationships (Kim et al., 2023a). The increased design of machines with natural, intuitive, and anthropomorphic characteristics emphasizes the growing importance of social presence.

However, we still need to clarify further the conceptual understanding of social presence in the HMC context. Although considerable effort has been invested regarding the multifaceted nature of the concept (e. g., Biocca et al., 2003; Lee, 2004) since its introduction (Short et al., 1976), the notion is still not firmly or universally defined or conceptualized. Whereas some scholars rely on definitions from the human-to-human context (e. g., Short et al., 1976), others base their conceptualizations on a broader scope, covering various agent types beyond humans (e. g., Biocca et al., 2003; Lee, 2004). Accompanying this, there still is a lack of consistent measures that correspond to the conceptualization. As a result, the insights differ tremendously. To continue to advance the role of social presence in HMC, it is essential to address how we conceptually and operationally define the notion in a more synthesized way.

The multidimensional nature of social presence is insufficiently covered in HMC research. While scholars have identified several dimensions of social presence such as copresence and psychological involvement (e. g., Biocca et al., 2003), there is a shortage of empirical research on this subject across different types of machine agents (e. g., robots, chatbots, voice assistants). As the field moves forward, we encourage HMC scholars to address this matter.

While social presence is often treated as a positive experience, we further advocate for addressing the essential question of to what degree social presence needs to be evoked or cultivated in HMC. The uncanny valley suggests that if a machine agent has too much human-likeness, users may develop negative

emotional responses toward the machine (Kätsyri et al., 2015). Relating this approach to social presence, to what degree should we consider fostering or evoking social presence? At a broad level, the ethical issues of machines becoming more like humans have already been discussed (e.g., Hancock & Bailenson, 2021). However, little research has addressed the potential perils of social presence in the HMC context. While social presence could lead to interaction experiences that feel like conversing with another human, this could potentially result in destructive consequences. When users continually and strongly feel social presence of their AI companion, this may lead to behaviors like reliance on a machine over a human, creating unrealistic views and perspectives of relationships, and isolation from natural human interactions. Acknowledging that technological advancement will continue to provide affordances that evoke a more substantial social presence, HMC research calls for finding ways to negate the potential perils of social presence.

Trust in Machines

The relationship between humans and machines, characterized by trust, has a long history. Famously, groups such as the Luddites, dating back to the 18th century, expressed deep mistrust by actively destroying machines they perceived as threats (Jones, 2013). By the mid-20th century, important figures like Alan Turing and Joseph Weizenbaum raised critical questions about the foundation of trust in machine counterparts regarding human cognition and conversation (Weizenbaum, 1966; Turing, 1950). Today, trust in machines is still pivotal due to technological advancements and industries' rapid integration of automation, wishing to nurture trust between their workforce and machines (Moritz & Smaje, 2022). Although human-machine trust relies on a vast expanse of research, it still faces challenges.

The primary challenge that we encourage HMC researchers to address is establishing a more solid understanding of the concept, both conceptually and operationally. Trust has been depicted in various theoretical models, encompassing everything from trust in fellow humans to animals, virtual agents, and social robots (Sundar, 2020; Banks et al., 2021). These models collectively contain an almost innumerable number of sub-concepts. As a result, trust is operationalized very differently among studies, ranging from the simple realization of the "Godspeed Questionnaire" (Bartneck et al.,

2009) to elaborated multidimensional measures (e. g. , Weidmüller, 2022). In addition, the discourse is further complicated by the repercussions stemming from (dis) trust in machines. Trust research is home to terms like "over-trust", signifying excessive reliance on automation (Wischnewski et al. , 2023), while on the other spectrum, phenomena like "algorithm aversion" are synonymous with "under-trust" or "mistrust" (Parasuraman & Riley, 1997). To establish a more systematic understanding of trust in machines, we advocate for a more careful conceptualization and operationalization of the concept in future HMC research.

Related to the above, another challenge is that perspectives on trust differ tremendously. Some studies conceptualize trust as a mental state or attitude. Such an approach is common in HMC literature where the technologies studied may be cutting edge or used in private home settings and thus unavailable for laboratory studies (e. g. , home assistants) (Lutz & Tamò-Larrieux, 2020; Weidmüller, 2022; Rosenthal-von der Pütten & Bock, 2023). Other studies conceptualize trust as a behavior, which is a common perspective on human-automation trust (for examples, see Dzindolet et al. , 2003; Huang et al. , 2021) and also in some HMC research (e. g. , Prahl & Van Swol, 2021). Whereas the former perspective invites the use of survey instruments and self-reports to measure trust, the latter demands actions to be taken and behaviors measured. While different perspectives provide diverse angles, these can prevent us from assessing comparability across studies. As the field advances, we, therefore, encourage future HMC scholars to carefully consider how we approach the notion of trust to produce a systematic understanding.

The third challenge is to distinguish the concept of trust from related concepts, such as trustworthiness. Trust and trustworthiness, for example, are often used as synonyms, although the first describes a mental state (or behavior) by the receiver of a message, whereas the second refers to the sender (Weidmüller, 2022). This ambiguity creates challenges for synthesizing the findings of the extant literature. The challenge demonstrated in this example does not just concern the conceptualization of trust. Therefore, we strongly suggest that HMC scholars further explore the boundary conditions of conceptualizations in trust research.

Last but not least, we consider it crucial for HMC research to identify the optimal level of trust in machines. Trust determines how people interact with (Li et al. , 2008) and influences the adoption of (Gefen et al. , 2003) a

particular machine. From a designer's perspective, it is reasonable to induce maximum trust. However, from an ethical and societal perspective, we observe an unrealistic automation bias (Cohen et al., 1998), inducing the potential harm of over-reliance on machines (Bussone et al., 2015). Therefore, despite the numerous benefits of machines, e.g., in the healthcare context (e.g., Abbas et al., 2018), we exhort HMC scholars to examine what the optimal level of trust is by taking into account various perspectives.

Implications for the Future of HMC

The proliferation of HMC scholarship corresponds with the escalating adoption of automation in both personal and professional spheres. This growth has enabled industry professionals, corporations, and policymakers to tread more confidently within the continually evolving maze of automation in communication. In this context, we delve into the ripple effects of HMC studies across practice, industries, and society, and discuss the implications for the future of HMC.

Implications for Practice and Industry

In the evolving landscape of HMC, interactions with machines are becoming more conversational, signaling a shift in traditional dynamics. However, there is an increased potential for reluctance to engage with machines if they fail to meet certain standards, whether in terms of the communication quality itself, anthropomorphization, privacy concerns, application in inappropriate contexts (e.g., empathy-driven roles), or other ethical concerns. Moreover, as we traverse this nuanced space, there is a burgeoning potential for uncanny valley effects as well as over-trusting machines. These dynamics underscore the urgent need for careful design and regulation to navigate the complex pathways that lie ahead in the realm of HMC. In this regard, the ramifications for practitioners and industry sectors are profound. Current observations offer glimpses into a future marked by deepening human-machine collaborations, challenges, and spaces for HMC research to contribute to practitioners and industries spawned by nascent technologies.

When machines make their mark in the workplace, professionals have to

rewire their routines, especially considering that today's machines assume a more dialogic stance than the past. Despite this advancement, a recurrent theme emerges: individuals mold workflows tailored to their unique strengths. Injecting enforced automation disrupts these processes, potentially leading to dissent, morale dips, and even rejection of the technology (Olakotan & Mohd Yusof, 2021). In this area, we see future research trajectory moving further from technological determinism perspectives as HMC researchers investigate how individuals shape technology/machines to complement their personal workflows.

HMC's wave will herald the decline of certain industries, simultaneously giving rise to novel ones. With the advent of Generative AI tools, traditional communication roles like editing, copywriting, and design might be overshadowed by faster, cost-effective machine communicators. Yet, this AI-driven landscape is not entirely bleak. Challenges like AI's propensity to generate spurious information spotlight the need for "veracity industries" that vet credibility (Alloway & Weisenthal, 2023). This domain necessitates human-machine collaboration, hinting at a symbiotic future. For HMC scholars, the direction is evident: delve into trust and credibility in human-machine interactions. While our earlier discussion on trust offers industry leaders a starting point, extensive research still beckons.

As we look further into the future of HMC research, there is a critical need for delineating roles between humans and machines. People view machines as experts in managing objective data (Prahl & Van Swol, 2021), while machines are less suited to the intricacies of emotion and creativity where humans excel (Takayama et al., 2008). There is a clear place for HMC research in this future: machines may outperform humans in specific communication tasks, but the challenge is designing machines that strike a balance between customization, task aptitude, and communication nuance. Such innovations will be informed by HMC research.

Implications for Society

The surge in the integration of conversational and social machines into our daily lives has begun to reshape previously unquestioned worldviews and ethical standpoints. In recent years, it has become clear that these developments provoke social reactions and empower us to redefine and expand

traditional categories, deepening our understanding of machines, the intricacies of the world, and human nature itself.

One of the most significant transformations occurs in the realms of sociality and our perspectives toward social machines, as highlighted in the respective sections on social presence and trust. With machines soon discerning our personalities and beliefs to communicate on our behalf, society is wrestling with the potential diminution of personal connections and the birth of new digital etiquettes and norms. As we move towards this era driven, in part, by machine communicators, the concerns intensify, necessitating comprehensive research explorations. The future of HMC research will continue to explore the reshaping of not only human-machine but also human-human connections, ensuring that machines do not distance us from our human essence.

Alongside, a growing concern is the inherent bias that machines may acquire. Because bias is an age-old human flaw, machines that draw insights from human-sourced data would inevitably acquire and replicate humans' inherent biases. Such complexities lead to imperative questions on bias recognition, resource allocation for de-biasing efforts, and moral obligations developers might hold (Sargent, 2021). Hence, future HMC research ought to address how to develop and integrate fairness in human-machine interactions.

Conclusion

In the fast-growing realm of human-machine communication, we are witnessing a transformative era characterized by collaborations between humans and machines, reshaping established norms, expectations, and ethical considerations. The field of HMC has explored this shift from perceiving machines merely as tools to recognizing them as digital interlocutors that shape our social realities. Through this lens, we examined theoretical foundations and methodological approaches, two prominent research frontiers centered on social presence and trust with machines, and wider implications.

As we move towards a future driven by machine-driven conversations, the challenges and opportunities multiply, touching diverse sectors, such as education, healthcare, legal, entertainment, and new industries spurred by emergent technologies. While machines offer efficiencies and advanced capabilities,

addressing the potential harms of over-reliance on machines and the decline in personal human connections is essential. We see the imperative of navigating and optimizing the synergy between humans and machines and the critical role of HMC research in doing so.

The onus is now on all parties involved in this era of machine-driven communication. Scholars are responsible for producing knowledge that can promote positive effects and negate the perils of machine-driven communication. Considering that HMC is a dynamic field with remarkable opportunities for fresh perspectives and approaches, the field's expertise in communication integrating various disciplines opens up sound investigation of relevant practical challenges. Practitioners and industry leaders ought to embrace a responsible evolution, fostering technology that amplifies efficiency and respects the intricacies of human nature and ethics.

Through diligent HMC research, we can pave a path for innovations that meld the best of human intellect and machine proficiency, steering towards a future that is not only technologically advanced but also nurturing a society where machines complement human endeavors responsibly and inclusively. Moving forward, the amalgamation of humans and machines beckons HMC researchers to engage in a deeper exploration of the challenges and opportunities arising in the melding of societal and technological landscapes.

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