Contesting Control with Automation in Technology-Mediated Interactions

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Abstract

With the growing use of autonomous systems in computer-supported communication(CSC) such as recommended text in emails, speaker tracking in videoconferencing or automated facial expressions in VR avatars, machine agency is increasingly becoming entwined with human agency in how we enact our identity through media. It is important to critically examine how this affects the way we communicate and how users engage with surrendering or maintaining control of their self-expression. Using the example of Mobile Robotic Telepresence, we demonstrate the use of the Contesting Control framework as a lens for examining interview and video data, to understand how control over automation is conducted in technology-mediated, social interactions. Reflecting on our ongoing work, we propose some additions to the framework and urge the research community to further examine the implications of automating mediated communication. In doing so we hope to inspire the design and development of autonomous technologies and features in this field.

CCS Concepts

• **Human-centered computing → Collaborative and social computing design and evaluation methods**; **Empirical studies in HCI**; **HCI theory, concepts and models**.

Keywords

telepresence, videoconferencing, autonomous systems, identity

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1 Introduction

As automation is increasingly being embedded in technologies for Computer-Supported Communication (CSC), it is important to consider the impact this has on how we express ourselves and connect with the world. From recommended text in emails and speaker tracking in video-conferencing cameras, to automated facial expressions in VR avatars and autonomous movement in Mobile Robotic telePresence (MRP), automation in CSC can take many forms [e.g., 11, 20, 30]. Using preliminary data on MRP interactions, we explore potential approaches for investigating the implications of this phenomenon with the aim of provoking a bigger conversation on the subject of automating technology-mediated social interaction.

Drawing on previous works on identity and the cyborg literature, we posit that any technology that mediates between a user's intentions and how those are manifested in social interaction bears an impact on the process of self-expression and therefore merits careful examination [31]. Our social identity does not exist outside of our technological reality; the technology we use affects how we communicate [1]. Previous works on the ethics of automation have also raised questions regarding the biases and power imbalances created and amplified by automation [3, 14, 36]. Therefore, we ought to remain critical over communication systems that automate various elements of social interaction (e.g., use of language, embodied movement, direction of focus). We might ask, how are those automated communicative behaviours configured (who/what decides over the optimal behaviour and how?), how much control

do users have over their (technology-mediated) self-expression, how do they make sense of this control and what impact does this have on communication? Beyond this, we ask, how should we study these phenomena so that we might capture the potentially problematic uses of automation?

Within our work, we approach mediated, social interaction as situated and emergent within the use of a given technology, during the communicative turns made by users [2, 25]. The behaviours (and elicited identities) that occur in a video-call are outcomes of that setting, and would differ if the same users were interacting via text. As such, we posit that the impact of automation can be found in examining lived reality, i.e., looking at how those turns are made and how they are experienced by the users. To that end, we use the Contesting Control framework (initially introduced to study interactions with autonomous systems in art performances) [7], as a lens for understanding how users surrender control to mediating technology during interactional moments.

In this paper, we focus on examining the reality of automation in MRP, as an exemplary case where the technology mediates almost every facet of the interaction experience. We look at preliminary data from video observations and user interviews in an attempt to understand how users' experience and engage with automation in this technology and draw out considerations for future research. This work can be read as a "prequel" to our ongoing research, where we reflect on the suitability of the Contesting Control framework and highlight emerging provocations that work in this area needs to address further.

2 Related Work

2.1 Identity

Identity is a complex concept explored across the arts, humanities and hard sciences. Perhaps identity is a performance [9, 19], in which the collective endeavour of social order and strata encourage us as humans to *be the masks* that allow us to engage in a social world. Perhaps identity is an inherent part of sociopolitical *discourse* that defines normality, which, through the power of subjective normativity, people must employ 'technologies of the self' to consistently work to ensure they fall within [16, 17]. Perhaps, in a globalised and capitalist-driven world, identity is even a chore, or a production, that must be perpetually worked at to construct our own 'Narrative of Self' [18].

Identity the result of a complex mix of influences but the common theme across contemporary definitions of identity is that it is an emergent and iterative outcome of social interaction. Technologies have overhauled how we interact with, understand, and position ourselves within the world around us. Technology has created, deliberately and coincidentally, limitless ways for us to alter and reflect our identities and contest or adapt to 'normal' narratives [28].

One such influence is highlighted by Russell Belk, who discusses *The Extended Self and the Digital World* [4, 5]. Belk highlights that possessions and people are a part of us, extending and defining and demonstrating our identities. In modern, technology-driven life we are pushed to be ever connected, ever curating the 'perfect' online version of ourselves. As we're-embody' ourselves online, our identities too become inauthentic and decentralised, forced to rapidly shift and shed at a never before seen pace.

Whilst identity cannot be pinned down to a set of attributes that stem from one source and one source alone, technology is increasingly calling into question what identity *means* in the modern world. It raises deeply personal and even frightening questions around who we are, how we exist amongst others, and if it is even possible to separate the self and technology in any meaningful way. This final question leads us to face the reality that technology is no longer a mere tool to be wielded by humanity, but perhaps an indistinguishable part of us.

2.2 Learnings from cyborg literature

In light of the rapidly shifting modalities of identity formation and expression, facilitated - and triggered - by technological innovation, contemporary thinkers have sought to re-examine identity and the factors that influence it. In *The Cyborg Manifesto* [21], Haraway highlights the breakdown of three boundaries: human-animal, human-machine, and physical-nonphysical. These breakdowns occur, as both result and impetus of our becoming cyborgs; "theorised and fabricated hybrids of machine and organism" p.7 [21]. As technology increasingly permeates our day-to-day, it is impossible to distinguish binary categories of the boundaries outlined above. The very definition of 'human' comes into question and machine and organism are reconceptualised "*as coded texts through which we engage in the play of writing and reading the world*" pp. 11-12 [21]. As these texts are redefined, our identities become more fractured, more abstract, and less unifying. Is an email I write using recommended text a reflection of my identity? Does the way in which my telepresence robot moves around other people align with proxemic norms in my culture [32, 34, 37]?

Of course, this is not the only way to conceptualise the cyborg. Many disabled scholars, activists, and artists claim cyborg as their identity and criticise Haraway for her neglect of disabled communities in her essay [23, 35]. For many disabled people[1] the cyborg identity is one which does not only permeate their daily lives, but one upon which their lives quite literally depend.

We can draw on the cyborg identity in discussions of automated CSC to make sense of a reality where both the human users and autonomous systems of a communication technology posses agency. We might thus try to understand where and how breakdowns in identity boundaries can occur during mediated interaction. For example, Due (2021) describes a telepresence robot treating patients as not quite a cyborg, but as *" simultaneously 100 percent (non-autonomous) robot and 100 percent doctor: He (it) is an assemblage that is oriented toward as the doctor but with limited semiotic robot resources."*: the user (doctor) is a person, but can only enact social behaviours afforded by the robot and will thus be perceived and responded to by others as a robotic doctor.

[1]We explicitly utilise identity first language e.g. 'disabled people' and not person first language e.g. people with disabilities. This is at the preference of the authors among us who are disabled and, as Cy. Jillian Reise; poet, activist, and cyborg said "Beyond the political and collective reasons for this choice (#SayTheWord), I don't like the preposition 'with'. Prepositions are for relationships; I am not in a relationship with disability" [35].

2.3 Contesting Control

The Contesting Control framework proposes a way of understanding interactions with technology, in which control is shared and contested between a human and an autonomous actor. The framework emerged from an integral reflection of three large-scale artistic works involving autonomous and/or physiologically controlled systems, i.e., a breath-controlled bull ride, a duet with a self-playing piano, and a brain-controlled movie [7]. More recently, the framework has also been employed to analyse the interaction between a musician and an AI-based Irish folk tune-improvising agent [6].

The framework proposes three dimensions for understanding the space of control between actors from the lens of the human actor: *surrender*, *looseness*, and *awareness* of control. In other words, in an interaction loop with an autonomous system, a human actor's choices may range from voluntarily surrendering their control over a system and of their own bodily response or battling with the system to stay in control. Furthermore, the grip over control may range from loose and imprecise (either due to unreliable technology or unpredictable mappings), to tight and skillful control. The human actor's awareness of these control dynamics can also range from attentive and purposeful, to unaware yet in flow with the system (in some cases). Between the extremes of each dimension lies a continuum which can be traversed during experiences with autonomous systems.

3 Preliminary Insights: Study on Automation in Robotic Telepresence

In MRP, the remote user's face is displayed on a screen that is mounted on a remotely-controlled, mobile robot (Fig. 1, left). The remote user can have a video-call with people co-located with the robot, and 'drive' the robot in order to move in that space. The user's perception of the world is bound by the robot's microphone, camera and movement capabilities and their actions are limited by the robot's affordances. This presents a situation where a person's enacted identity is almost entirely mediated by the technology they are using [10, 15].

Automation in MRP often involves 'streamlining' the robots' movements (e.g., tracking and following local interactants, adjusting appropriate interpersonal distance [27, 30]) but also other forms of self-expression (e.g., gaze direction, size, and even speech or writing [12, 22, 24, 26]). In our data we look at two robots with autonomous navigation, Double 3 and Temi, in which the user can instruct the robot to go to a selected point in the environment. In addition, Temi has a 'Follow Me' feature that automatically follows a local person. This can be initiated by the remote user or by the local person being followed and can be interrupted by the remote user at any time.

In this section, we examine data from an ongoing study in which participants are screen recorded while they test the robots (in a randomized order) and are interviewed about their experiences. At the time of writing we have had 6 participants (3 male and 3 female, aged 27-74), recruited through personal networks.

First, the participants were shown how to use the robots, as they were unfamiliar with the technology (5 minutes per robot). Then they used them in a task that involved exploring a room (living room and kitchen space), being shown 6 decorative objects (e.g., a teddy bear, a desk lamp, a book) and communicating with a researcher about where to place the objects in the room (3 objects per robot, about 25 min per robot). There was no time limit or incorrect answers. Throughout the tasks, the participants were reminded of the robots' autonomous navigation features, but were not forced to use them. Following that, the participants took part in a 30-minute, semi-structured interview, where we asked them how they found the experience of performing the task in a robotic form, what features they liked or disliked, and how they felt about the robots' autonomous navigation.

3.1 Observing Contesting Control in interaction

Here we present an interaction that occurred during the study's task which exemplifies the reality of Contesting Control on a telepresence system. This data was captured by screen recording the participant's screen while he is operating the Temi robot. We employ an interaction analysis approach (i.e. looking at the moment-by-moment interaction with technology) to unpack the video fragment [8]. This qualitative, analytical technique is based on Ethnomethodology and Conversation Analysis (EMCA) and focuses on closely examining the impact of participants' actions to understand how the interaction is structured and how the participants make sense of the situation [33].

The images in Figure 1 (right) are showing the Point Of View (POV) of the participant (remote user). Prior to the start of the fragment, the remote user has expressed wanting to go to a certain part of the room (by the armchair). As he is about 'drive' there, the robot starts lagging. In frame 1, he exclaims 'Minor issue is that I think we're frozen' as his interface becomes unresponsive.

The researcher (and first author of the present work) decides to help by using the 'Follow Me' function in order to lead Temi to the armchair herself. From the local side, this function is activated by tapping the robot. In frame 2 of Figure 1, we can see that the remote user's POV has moved slightly (the interface is 'unfrozen' but still lagging a bit). The 'Follow Me' function has been activated as the status 'Following' has appeared at the top of the screen. Realising he is unfrozen, the remote user announces 'Oh no we're back, okay' and presses the left arrow key (this is evident as the left arrow is highlighted on the interface). In doing so, he overrides 'Follow Me' and returns to manual control.

In frame 3, the status at the top of the screen has changed to 'Manual Driving', as a result of the user pressing the left key. On the local side, the researcher has seen that 'Follow Me' did not work, and, as shown in the image, she taps the top of the robot a second time. However, at the same time as this is happening, the remote user once again presses the left arrow key (highlighted in frame 3), which again immediately cancels 'Follow Me'. These interactions happen almost simultaneously (and amidst some lagging), so it is not evident whether the remote user is intentionally overriding the 'Follow Me' function, or simply trying to make the robot move.

During this interaction, the researcher is not privy to the remote user's actions. From her perspective (which we know, as she is the present author), the robot is refusing to follow her because it is lagging. As such, she taps the robot a third time, and this time the remote user does not interfere.

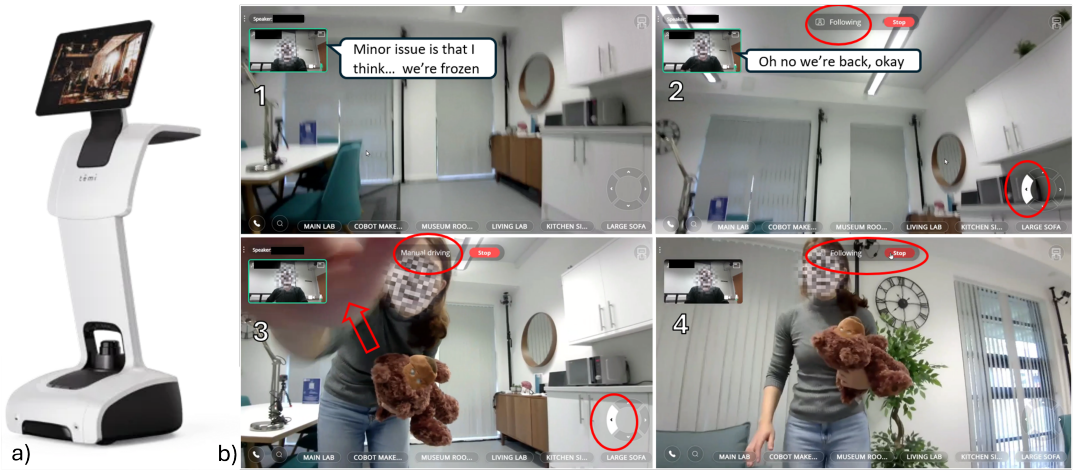

Figure 1: a) A Temi robot. b) Screenshots of a remote user's Point of View, showing the interface of the Temi telepresence robot.

In frame 4 of Figure 1, the researcher has led the robot to the desired destination (the armchair). As they are arriving, the remote user ends the 'Follow Me' function by pressing the 'Stop' button that appears next to the 'Following' status indicator.

From the perspective of the Contesting control framework, we have just seen an occasion where the user has ultimately surrendered control over the movement of the robot (and thus surrendered control over how he is positioned in the room). Before the *surrender* happens, we see a sort of 'battle' where the researcher and participant are claiming and reclaiming control over the robot. This part of the interaction is characterized by a lack of communication where neither side understands what the other side is intending to do. The *looseness* and *awareness* dimensions of the framework are also brought to relevance. The grip over the control of the robot's movement is fairly *loose*, which contributes to the 'battle'. When 'Follow Me' is active, any action by the remote user reverts it to manual control. As we see, at first the user keeps —perhaps unwittingly— canceling 'Follow Me'. Later, when they have arrived at the destination, he regains control in a more intentional way by pressing 'Stop'. Whilst we can not infer as to the remote user's *awareness* during the initial 'battle', he may not have been fully aware of the fact that his pressing of the left key was interrupting the 'Follow Me' function. Later when interviewed about it, he reported finding that feature useful, indicating that he did not have a problem with surrendering control. On the local side, we do know that the researcher was not aware as to why the 'Follow Me' function kept getting interrupted.

3.2 Users' thoughts on automating their telepresence

Next, we present interview excerpts in which participants express their thoughts on the robots' automation features. When initially asked, our participants had overall positive reactions to the automation. They were particularly positive about Temi's autonomous following feature. As one person reported, *"What's nice about [Temi] is the 'Follow Me' thing. That's really nice and easy to use and could be quite useful if you were getting very tired as a person that was operating it. It's quite nice for someone else to be able to do bits of it for you, so that you're not constantly using keys and things. That gives you a minute to have a bit of down time and rest a minute while somebody else is helping."*
The automation here is seen as a form of help which alleviates from any fatigue caused by operating the robot and surrender is made willingly.

To probe participants to reflect on their experience, we then asked how they felt about not being in control of the robot's movement. To this, participants explained that they did not mind because they could take back control if they wanted to. One participant specifically reported not trusting the robot to make decisions by itself in social contexts, and thus wanting to be able stop the robot if necessary: *"I could stop the robot before it came so close as to do something rude.[...] It gives me the kind of control that I need in order to know that I can make the right decision and stop the robot from doing something wrong. So the trust is really in need. It's just that, it's the control of interface that I have trust of, not the robot."* The ability to interfere, which can be associated with the *looseness* of the interface and *awareness* of how it works, is seen as vital in feeling at ease with automation.

The above excerpt, in referring to rudeness also highlights the social dimension as another key consideration in automating CSC. Such technologies are meant to be used with and around people, and as such the outcomes of automation might impact how the user is perceived by others (their enacted social identity). As that participant further explained, *'having my face on something that just hurt you, that would bother me'*, explaining that he felt responsible for the movement of the robot even if it was operating autonomously.

Reflecting on the feeling of not being in control, another participant described wishing that the 'Follow Me' feature allowed for some shared control. Currently, as soon as the user interacts with the interface in any way, the automated following stops and reverts to manual control. This means that the user either has full manual control of the robot's movement or no control at all. As the participant said, *"I did take control a few times. Like when he wasn't detecting you turning around, so I could see you. But it switches*

between Manual and Follow constantly. So maybe [it could] leave a bit of manual just to tilt. So that even when you follow, you can still look around. Because when you're following as a person [...] you look around, you look back, you know? There's a bit more immersion to the space than just following the person." Having the option for some manual control, whilst automated driving is happening, could, for example, allow the user to adjust their gaze. This would allow the user to explore the environment as they wish (rather than keep looking at what the robot has decided they should be looking at. This raises a point about considering what impact the automation of one modality (e.g., movement) might have on other behaviours (e.g., gaze).

4 Discussion

Approaching identity as a complex process and drawing on the cyborg literature, we make the case that automation features embedded in CSC ought to be examined for the impact they have on mediated interaction and with sensitivity to how the users' identity and sense of control over their self-expression is shaped.

Here we have begun an examination into how this issue manifests in robotic telepresence (MRP), through interview and video data, aiming to capture the users' subjective thoughts on, as well as the interactional reality of surrendering control over one's actions to an autonomous system. We find that whilst users generally like allowing the robot to move autonomously, this is only under the knowledge that they are able to intervene and regain manual control whenever they want. In that sense, the users were not describing an impact on their self-expression (or identity), but rather, they were thinking in more practical terms relating to the effort of controlling the technology.

Still, when asked to elaborate on this experience, users did express concern over the technology behaving appropriately on their behalf. Regardless of what elicited the movement, the fact that it represents the user (e.g., their face is on the screen), made users feel that the actions of the robot were their responsibility. As previous literature discusses, it is difficult to draw the human-machine boundary [21]. The MRP assemblage is both machine and person, but it is only the person here that can feel embarrassment and receive the negative repercussions of socially inappropriate behaviour.

In addition, we identified issues around the degree of control (or *looseness*), with users wishing for more shared control or unwittingly seizing control. The intersection of precision of control and social identity is brought to bear here as a user might be willing to relinquish control over their movement (accept to be led) but still wish to have control over their gaze as a form of self-expression and communication (to maintain eye contact, look around, or even use gaze as a form of embodied language).

These preliminary findings indicate that there is a wide scope of examination in the design of user control over automation in tech-mediated interactions.

4.1 Understanding the impact of automation

As we proceed with our research we are continuously thinking about how to ensure that our methods capture all relevant —and potentially problematic— facets of automation in technology-mediated interaction. Looking at this from the lens of identity, we want to gain insight into the moments of tension in the human-machine boundaries where social behaviour is a result of human agency coupled with machine agency. Within this, we want to examine not just the design of automation (e.g., how autonomous movement works), but also the design of user control over that automation (how, why, when and how easily does the user surrender and regain that control).

First, as demonstrated in section 3, we have found that capturing video data of interactions can be useful in allowing us to unpack how control is enacted in practice. Seeing how the user engaged with the interface showed us at which points in an interaction the user might be happy to surrender (e.g., when moving between points) or regain control (e.g., when reaching the point of interest), but also how easy or difficult it is do so, as well as how they might (or might not) communicate their intentions around this.

So far, we have found the first-person perspective data (screen-recording the user interface) to be the most enlightening, as it shows the actions of the user. However, cameras placed in the task environment are also useful in understanding how the actions of the user are enacted by the robot. In digital-only or non-embodied technologies (e.g., video-conferencing, texting), this might entail capturing the screen of the other user(s), to see how one person's actions are experienced by their co-interactant(s). In addition, researchers sitting next to the participants during our studies have noted behaviours that are not captured in the screen-record data (e.g., what the user is doing when the interface is lagging). As such, future research would benefit from capturing all angles of the experience (the user, their interface and the other side of the interaction).

Whilst the video data was insightful in showing us how users *do* Contesting Control, we have found follow-up interview data to be necessary to contextualize the motivations behind those actions. For example, we learnt that users did not see autonomous movement as *losing* control, but as being helped. This angle has been particularly useful in understanding the *awareness* dimension of control. Whereas, the video data can show us that the grip over control could be *loose* (e.g., the members in the video fragment kept losing and regaining control), we could not infer whether the participant was doing this intentionally until we asked him. This in itself demonstrates that the behaviours around surrendering/regaining control enacted in mediated interactions are also not transparent to an observer or co-interactant.

Regarding our interviewing approach, we have been starting with general questions (e.g., how did you find using the robots?) and then moving to more specific ones (e.g., were you able to explore the room sufficiently?). With regards to understanding user views around control, questions that are geared towards eliciting reflection have best allowed users to verbalise their thoughts. Asking participants how they found the automation features of the robots yielded fairly short, superficial answers (e.g., "I liked it"). Asking how they felt about being/not being in control of their movement elicited more nuanced perspectives (e.g., the participant wishing for shared control). Questions about their perceived identity (e.g., would you be okay with a robot that represents you moving by itself in a public space?) resulted in users expressing concerns around socially appropriate behaviours and sharing their thoughts on trusting the technology to act on their behalf. As such, we recommend

that future studies on this topic incorporate questions that probe reflection (e.g., Do you feel that [actions made by automation feature] represented you? Would you be happy for [technology] to [do x automation] on your behalf in [a specific social situation]? Why/why not?).

4.2 Using the Contesting Control framework

We found the Contesting Control framework to be a useful lens for understanding the data and narrowing our focus on aspects of the interaction that relate to control. As demonstrated in the work we have presented so far, the dimensions of *surrender*, *looseness* and *awareness* help articulate what is happening in the data, and could allow us to focus on those elements as points of discussion and design improvement. Our analysis, however, has revealed additional dimensions not explicitly covered in the framework.

Namely, the framework does not allow for a more fine-tuned analysis of compartmentalized or *shared* control [29]. In the example of the participant wishing for the ability to control gaze during autonomous movement, it is evident that control is loose, as the user is able to immediately regain it. However, when examining the excerpt, we see that it is not the looseness of control that the user was really concerned with. In this case, the participant was happy for the movement of the robot to be automated, but wanted some control over the direction of the camera (the equivalent of turning one's neck instead of turning the whole body). A *shared* control dimension acknowledges the fact that an interaction technology can have several modalities, and that each one could be automated and contested separately. In terms of design, we could outline all areas that might be automated (for e.g., in videoconferencing: camera direction, focus, zoom, sound volume, panel positioning) and look at where and how control should be given to the user.

In addition, while the framework highlights *awareness*, this refers to the psychological state of the user and not awareness on the interactional level. In the context of communication, the shared understanding of a situation by all involved interactants is vital. In our interview data, participants discussed feeling responsible for how the robot moves even when done through automation. Since their face is on the robot, its behaviour is ascribed to them, even if they didn't cause it (at least this is how they perceive the situation). In the video data, the researcher was not aware that the participant kept overriding the automated following nor whether this was intentional. This suggests that the system is not sufficiently transparent in communicating to relevant interactants when automation is in effect, who initiated it, and how it is affecting the elicited actions. As such, we might also add *transparency* as an additional dimension when examining contesting control in CSC. Addressing transparency, would involve understanding *in what cases* the use of automation needs to be communicated (e.g., the autonomous agent does something rude), as well as *when* and *how* this can be done effectively (e.g.,in advance, throughout use or at the moment it occurs, thought text, visuals or other symbols).

Finally, another aspect of control that arises in our data is the matter of timing. Participants described wanting to be able to regain control *before* the robot did something inappropriate. In the video fragment, we see the participant stopping the 'Follow Me' feature just as the robot arrives at his desired destination. There is, here, a sense of urgency or vigilance, and the idea that control will be regained *just in time*. In other media, this might not be the case. For example, in automated email replies, the user sets responses to be sent under certain conditions in advance (control is done before the interaction). In autonomously generated text, the user sees the recommended text before it is implemented in their text and can further alter once they have accepted it before sending the email (control is maintained throughout). An additional *timing* dimension might then allow us to gain a clearer understanding of control design, by prompting as to think about when control should be made possible during use and what impact this might have on the users' experience.

4.3 Future Work

In presenting this work, we have brought the subject of user control over automation in CSC to the forefront, provided the language for more critical examinations in this area and presented an example of how such research may be done. We hope that future work will apply the Contesting Control framework onto other CSC technologies and further refine the use of our proposed additional dimensions (shared control, transparency and timing).

We also acknowledge the limitation of using a lab setting in the present work. Future studies should take this work into real-world settings, and examine interactions in social contexts. Where our participants reflected on hypothetical scenarios, future research should examine how control over automation will be handled and experienced in reality. Future research might also incorporate quantitative measures through interaction metrics (e.g., frequency of control transitions, reaction times) to further validate effective design of control. Moreover, in our current research, we focused on the perspective of the user whose actions are automated. Complementary research should also explore how such identities are perceived by the other interactants.

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