How Does the Internet Change Group Processes?

Applying the Model of Collective Information Processing (MCIP) to Online Environments

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Abstract

The internet seems to be a breeding ground for both negative and positive social phenomena, e.g., not only radicalization and the spread of misinformation but also social connection and knowledge gain. Although these topics are inherently social, they are typically researched on the individual level. This contribution develops a theoretical framework to explore them on the group level, e.g., in e-communities, online social movements, or online discussions. Drawing on concepts like social identity and the model of collective information processing (MCIP), it adopts a collective information processing perspective on online group phenomena. Then it reviews how different collective processing modes (automatic vs. systematic and closed vs. open) can interact with the internet's core technical possibilities (participation, selectivity, interaction, interconnectedness, and automatization). Online spaces appear to work as a catalyst for any collective processing mode; however, closed and open modes may raise the greatest risks and opportunities for societies. This work may inspire new questions and approaches for future research on social phenomena online.

Digitalization has fundamentally changed the conditions of discourse. For society, these changes seem to be both a blessing and a curse. On one hand, they allow for an entirely new dimension of radicalization (e.g., Wojcieszak, 2010) and misinformation (e.g., Dan et al., 2021), amplifying hate (e.g., Brown, 2018) and polarization (e.g., Neudert & Marchal, 2019). On the other, they offer more possibilities for social connection (e.g., Ruesch, 2013) and knowledge gain (e.g., Engel et al., 2014), paving the way for new forms of empowerment (e.g., Brady et al., 2017) and deliberation (e.g., Min, 2007). What all these phenomena have in common is that they are inherently social. They usually refer to perceptions and behaviors of groups or individuals as group members. Therefore, they can unfold

their full potential only through the collaboration of individuals. In a broader sense, they can be conceptualized as collective information processes and their outcomes (Hinsz et al., 1997; Schindler, in preparation). Yet, although human beings are specialized for group life, communication studies—and social sciences in general—have traditionally focused on the individual level (Brauner & Scholl, 2000; Poole et al., 2004). In the present contribution, I explore the flip side of the coin and focus on processes at the group level. From a group perspective, social habits that have evolved over thousands of years under offline conditions collide with entirely new technical possibilities online. A theoretical framework for the interaction between collective information processing and the infrastructure of online spaces might help us to understand what is unique about social phenomena online. Thereby, it may serve as an inspiration and foundation for future research. Although the present work focuses on the group level, several of its assumptions might also apply to individual information processing online.

Thus, this theoretical contribution seeks to conceptualize how online environments shape collective information processing. For this purpose, I extend the propositions of the model of collective information processing (MCIP, Schindler, in preparation; for a first draft see Schindler & Bartsch, 2019) from small, face-to-face groups to large groups online. In doing so, I link theoretical and empirical literature from multidisciplinary fields such as social psychology, small-group research, communication studies, and computer-supported cooperative work. My contribution begins with an overview of the foundations of collective information processing (i.e., the concepts of social identity, small groups as information processors, and their application to large groups online). On this basis, I introduce four basic modes of collective information processing based on the MCIP (i.e., automatic vs. systematic processing and closed vs. open processing). Next, I summarize core technical possibilities of online environments (i.e., participation, selectivity, interaction, interconnectedness, and automatization) based on Neuberger (2018). Drawing on these concepts, I then review how each mode of collective information processing might interact with the technical possibilities online. In the final sections, I discuss these insights and outline their implications for future research and for society.

The Foundations of Collective Information Processing

The following sections address the key concepts relevant to collective information processing. The first section introduces social identity (Tajfel

& Turner, 1986) as a social psychological basis for group processes. The second section deals with the conceptualization of small groups as information processors as introduced by Hinsz et al. (1997) and adopted by the MCIP (Schindler, in preparation). In the third section, the idea of collective information processors is applied to large groups in online settings. This perspective provides the foundation for grasping collective processes on the internet.

Social Identity

For humankind, living in groups is existential. Belongingness is a basic human need (Fiske, 2000), and human cognition is "truly social" (Caporael, 1997, p. 277) in that individual processes are closely knit to their social environment. This background leads to the assumptions of social identity theory (SIT) (Tajfel & Turner, 1986): According to SIT, humans perceive not only others but also themselves through social categorization (Turner et al., 1987). They can, thus, not only take on a personal identity (I vs. you) but also a social identity as part of a social category or group (we vs. you). In this "we mode," individuals internalize their group membership as part of their self-concept and think as representatives of their ingroup. Through the lens of social identity, ingroups and outgroups are prototypical constructs accentuating differences between each other. Consequently, individuals perceive personal characteristics of themselves and others as less striking (depersonalization or stereotyping). Individuals can dynamically switch between various personal and social identities depending on which identity is salient in a specific situation. However, only one identity can be present at any given moment (Hogg et al., 2004; Tindale & Kameda, 2000).

There are two primary motivations behind social identity processes. The first is self-enhancement; humans strive for positive distinction, which they can achieve by joining a group and comparing it positively to other groups. The second motivation is uncertainty reduction. Social categorization helps reduce perceived uncertainty about the self and the social environment (Hogg et al., 2004).

Originally, SIT referred to intergroup processes between large social groups but was also applied to small groups later (Hogg et al., 2004). The social identity perspective helps explain how people can become part of a group and why they might adapt their perceptions and attitudes to align with this group.

Small Groups as Information Processors

The social orientation of human beings gives them special possibilities for cooperation. Concerning small groups, Hinsz et al. (1997) developed the concept of groups as information processors. Their comprehensive review of group research showed that collective and individual information processing involves highly similar elements. As on the individual level, information processing on the group level includes objectives, attention, encoding, storage, retrieval, processing, responses, and feedback. To process information collectively, however, groups need to fulfill two requirements. The first is that they need a basic amount of social sharedness, a concept referring to the extent to which states and processes are shared among group members. Social sharedness can, e.g., relate to information, attitudes, motives, norms, identities, cognitive processes (Tindale & Kameda, 2000), and plausibly also emotions (Smith, 1993; Smith et al., 2007; van Kleef & Fischer, 2016). It is, therefore, strongly linked to the concept of social identity (see above). The second requirement for collective information processing is a combination of contributions and relates to how groups (a) identify relevant contributions of group members and (b) combine these contributions on the group level. Such contributions can include resources, skills, and knowledge. Their combination works via an interactive process of aggregating, linking, or transforming (Hinsz et al., 1997).

Apart from structural commonalities, there are differences between individual and collective information processing. Only group processes are dependent on social sharedness and shaped by additional factors like group norms, majorities, and leaders. From a group-level perspective, these social influences are not confounders but part of the collective process. They allow the group to maintain its social identity and unity. Accordingly, they also benefit individual members as they depend on belonging to a group (see above; Hogg et al., 2004; Tindale & Kameda, 2000). As a result, groups tend to process information even more prototypically (i.e., accentuated and homogeneously) than individuals (Chalos & Pickard, 1985; Hinsz et al., 1997, p. 50).

The information processing perspective on groups has been adopted by the MCIP to describe, explain, and predict the collective processing of (media) information via different processing modes (Schindler, in preparation). Thus far, it has focused on small groups in face-to-face settings. However, it demonstrates that groups can be conceptualized as meaningful information processing units in general. In the following, this fundamental idea will be transferred to larger groups in online settings.

Application to Large Groups Online

Collective information processing traditionally occurs face-to-face in small groups like families, friends, or co-workers. Such groups can, of course, use online channels as well to process information collectively; however, online spaces offer new possibilities for larger groups to engage in efficient collective information processing (see below for details). At the same time, not every group phenomenon on the internet meets the relevant criteria. Dolata and Schrape (2014) described online collective formations from an actor-based social theory perspective, differentiating between non-organized collectives (e.g., masses, crowds) and organized collectives (e.g., social movements, communities). Non-organized collectives may exhibit social sharedness to a minor degree but cannot perform combinations of contributions; their collective behavior can result only from an aggregate of individual actions. Organized collectives, in contrast, share a social identity, norms, or goals, which might generally enable them to act—or process information—collectively via some form of social sharedness and a combination of contributions (Dolata & Schrape, 2014). In the following, the term "groups" refers to collectives with at least some type of social sharedness performing at least some kind of combinations of contributions. Thus, it includes not only tight-knit online communities but also, e.g., groups of random users with the shared motivation to discuss an issue in a comments section.

Empirical evidence shows that larger groups in online spaces can, indeed, engage in collective processes similar to those of smaller face-to-face groups. This analogy is supported by findings from the field of computer-supported cooperative work (CSCW), an interdisciplinary research area focusing on how people collaborate with the aid of computer systems. Apart from organizations, the field investigates groups on social platforms as well, including social movements (e.g., #MeToo), peer production communities (e.g., Wikipedia), or gaming communities (e.g., World of Warcraft). In a systematic review of CSCW literature, Seering et al. (2018) provided evidence that the principles of social identity known from offline research also apply to groups in online spaces. For example, internet users seem to switch between different social identities and associated self-presentation and communication norms depending on specific contexts (e.g., Marwick & boyd, 2011). Moreover, it appears that online groups with the goal of advocating their identity have stronger social identities (e.g., De Choudhury et al., 2016). Members of online groups with strong social identities, in turn, seem to engage in more one-to-many reciprocity, i.e., collaboration with group members they don't know personally (e.g., Liu et al., 2016).

Social identity on the group level is directly linked to socially shared states and processes and the ability to combine contributions of individual members interactively (see above).

In summary, there is theoretical and empirical support that a basic collective information processing perspective can be helpful for conceptualizing group processes on the internet. Even though online groups might be large and lack direct contact between each of their members, they appear to be capable of social sharedness and combinations of contributions.

Modes of Collective Information Processing

I have demonstrated that online groups can act as information processing systems. Thus, general principles of human information processing known from individuals and small groups may also apply to them. In the following sections, I introduce two dimensions of information processing: (1) the automatic vs. systematic continuum and (2) the open vs. closed continuum. Both are well-known on the individual level and have already been transferred to small groups within the framework of the MCIP (Schindler, in preparation; Schindler & Bartsch, 2019). They could, thereby, also help to systematize different modes of information processing in online spaces.

Automatic vs. Systematic Processing

First, numerous dual-process models of individual information processing distinguish between an "automatic" and a "systematic" mode (but using different labels). These models include, e.g., the elaboration likelihood model of persuasion (ELM; Petty & Cacioppo, 1986), the heuristic-systematic model of information processing (HSM; Chaiken et al., 1989), the limited capacity model of motivated mediated message processing (LC4MP; Lang, 2006), and the affect infusion model (AIM; Forgas, 1995). Automatic information processing requires only minimal motivation and cognitive resources; it works superficially and often unconsciously. Systematic information processing, in contrast, is associated with high levels of motivation, mental effort, accuracy, and consciousness (Chaiken et al., 1989; Forgas, 1995; Lang, 2006; Petty & Cacioppo, 1986). Automatic processing is the default mode but can be supplemented by systematic processing, resulting in a continuum between both extremes (e.g., Petty & Wegener, 1999).

Results of small-group research imply that the distinction between automatic and systematic information processing also applies to small groups in face-to-face settings (De Dreu et al., 2008; Hinsz et al., 1997). This assumption is supported by, first, qualitative (Schindler & Bartsch, 2019) and then quantitative (Schindler, in preparation) evidence. Thus, small groups can process information either automatically, relying on common knowledge and simple heuristic cues, or systematically, engaging deeply with the topic and related arguments. Later, the same distinction will be applied to interpreting research results on group processes online.

Closed vs. Open Processing

Second, some approaches differentiate between a "closed" and an "open" mode of individual information processing (applying different labels, again). These approaches include, e.g., the theory of lay epistemics (Kruglanski, 1989), the concept of motivated reasoning (Kunda, 1990), the HSM (Chaiken et al., 1989), and the AIM (Forgas, 1995). Closed information processing is directed toward reaching or maintaining a specific, predetermined result. Conversely, open information processing is associated with the willingness to accept different results. Again, both modes build a continuum rather than two completely distinct modes (Kruglanski, 1989). The automatic vs. systematic continuum and the closed vs. open continuum represent two orthogonal dimensions of information processing (Chaiken et al., 1989; Forgas, 1995; Kunda, 1990). Their respective modes can, therefore, be combined with each other, e.g., systematic and open processing.

Again, the distinction between closed and open information processing can be applied to small groups in face-to-face settings. A first qualitative (Schindler & Bartsch, 2019) and quantitative (Schindler, in preparation) study implies that small groups can process information either closed, reproducing and justifying established views, or open, engaging with new pieces of information and positions. Therefore, the same distinction will be applied later to review the literature on collective information processing in online spaces.

Technical Possibilities in Online Spaces

The last two sections have focused on grasping the concept of collective information processing, especially by groups in online spaces. It has been shown that, essentially, they engage in identity-driven processes similar to those of smaller face-to-face groups. However, the internet offers technical possibilities that are entirely new in human history. Based on Neuberger (2018, pp. 15–17), the next sections introduce five core technical possibilities of the internet relevant to a social dimension: (a) participation, (b) selectivity, (c) interaction, (d) interconnectedness, and (e) automatization (originally labeled "transparency"). The factor of selectivity has been added to Neuberger's (2018) original list as it seems critical for some group processes online. The following sections outline how these factors are connected to group processes in general, making collective information processing possible online. After that, they are linked to the different modes of collective information processing (see above) in order to better grasp what makes the internet such a special environment for groups.

Participation

The internet enables users to participate in public discourse and other social processes. Not only can online users passively follow these; they can actively contribute to them (Neuberger, 2018, p. 16). Hence, groups and individuals—particularly social or political minorities and their members—can become more involved and more visible online.

Selectivity

In many online contexts, it is common and easy for users to obscure specific individual characteristics and emphasize others. Thereby, they can choose any (social) identity, and accordingly, they can often decide how to act with no consequences for their offline lives. This freedom could be especially important for groups and their members who are less socially accepted. It also enables groups and individuals to easily violate societal norms.

Interaction

While traditional media environments have offered few opportunities for follow-up communication, online spaces enable extensive and complex interactions. These can occur between various actors (Neuberger, 2018, p. 16). Interactions are a fundamental requirement for combinations of contributions (see above) and, therefore, for collective information processing within groups. Moreover, online environments enable interactions between groups and, therefore, pro-social and anti-social intergroup processes of all kinds.

Interconnectedness

The internet offers new possibilities for people to connect independent of time and space. In addition, content can be linked much more efficiently (Neuberger, 2018, p. 16). Consequently, individuals are able to build groups that wouldn't exist offline. The interconnectedness of groups' members and information (e.g., via hashtags) might generally contribute to effective collective information processing via social sharedness and a combination of contributions.

Automatization

Algorithms and artificial intelligence allow online information processing to become more effective—or biased—than it has ever been before. Furthermore, content can be precisely personalized to online users, as platform providers can collect fine-grained data on user characteristics (Neuberger, 2018, pp. 16–17). Thus, groups and their members have the ability to find exactly what they are looking for online. Platforms also actively offer information tailored to their needs.

Modes of Collective Information Processing in Online Spaces

Two factors are demonstrated in the previous two sections. First, groups seem to process information in different modes, i.e., on an (1) automatic vs. systematic continuum and on an (2) open vs. closed continuum. Second, online environments essentially offer five new possibilities in social

terms, i.e., (a) participation, (b) selectivity, (c) interaction, (d) interconnectedness, and (e) automatization. These concepts build the foundation for exploring how online spaces might shape collective information processing. The following sections review each combination of processing mode and condition; they also address corresponding literature and empirical evidence.

For Automatic Processing

Online environments provide groups and their members with new and even more accessible opportunities for automatic information processing. The *participation* of many group members should lead to a broader foundation for majority cues. As in offline settings (Tindale & Kameda, 2000), group members in online settings tend to base decisions on majority cues within their group (Go et al., 2014).

Selectivity in terms of personal identity may lead to more apparent authority cues or expert cues in online spaces, as a small, selected set of user characteristics stands out more prominently. Leaders or experts have been shown to influence groups and their members offline (Hogg et al., 2004) and online (Kanthawala & Peng, 2021). Likewise, social identity cues can be more prominent online. They could, thus, reinforce any automatic mechanisms associated with ingroup or outgroup membership, e.g., the application of prejudice (Dotsch & Wigboldus, 2008; Dovidio et al., 2010).

Online *interaction* helps groups easily generate heuristic cues, e.g., identifying the majority position or asking trusted group members (see above). Similarly, the *interconnectedness* online facilitates access to existing heuristic cues, as they might be just one click away.

Finally, *automatization* provides an ultimate aid for automatic information processing in online spaces. Groups can find information with the least amount of effort or are even proactively recommended tailored content. Just as individuals do (Wirth et al., 2007), they might often process such pieces of information in an automatic mode.

For Systematic Processing

In contrast, the internet allows new and powerful possibilities for systematic information processing in groups. The *participation* of a large number of members enables an entirely new level of collective intelligence. Offline

and online studies have demonstrated that groups can solve problems better than individuals (Laughlin et al., 2006; Schmidt et al., 2001). A meta-analysis on collective brainstorming has shown that larger groups outperform smaller groups—especially when they collaborate virtually (Dennis & Williams, 2007). One of the best-known examples is Wikipedia.

Selectivity online might also aid collective systematic information processing via a more salient social identity. As collective information processing depends on social sharedness (see above), a stronger social identity could facilitate group performance. This idea is supported by the results of an online experiment on creative performance in groups (Guegan et al., 2017).

Interaction is critical for collective information processing (see above) and especially for challenging tasks. Therefore, effective solutions for online group communication should promote systematic modes as well. It has been demonstrated for online and offline teams, for example, that more communication is associated with higher scores in a test of collective intelligence (Engel et al., 2014). Similar to measures of individuals' general intelligence, this test gives groups a variety of cognitive tasks to be performed together (A. W. Woolley et al., 2010).

Furthermore, the special tools for *interconnectedness* in online spaces could contribute particularly to collective systematic processing as they allow for a new level of combinations of contributions (see above). Various examples show how local communities have utilized such opportunities to perform highly effective crisis management online during violent attacks or natural disasters, e.g., to efficiently organize information and assistance (Büscher et al., 2014).

Ultimately, *automatization* can also aid systematic collective processes in a unique way. Algorithms allow for a broadly-based and in-depth information search not possible for human groups alone. Likewise, collaborations between humans and artificial agents may enable an entirely new level of intelligence, mutually compensating for the weaknesses of collective and artificial intelligence (Peeters et al., 2021).

For Closed Processing

Online spaces can support closed information processing in groups under entirely new conditions. As *participation* on the internet is hardly restricted, it is easier for any social and political groups to take part in public discourse. Through online social movements, they can recruit a large number of members to work collectively toward their goals (Jost et al., 2018).

Examples include the Fridays for Future, #BlackLivesMatter, or #MeToo but also right-wing extremist or Islamic extremist groups.

Selectivity online can also shift the focus to certain social identities instead of diverse personal identities (see above). Consequently, groups might develop stronger social sharedness of motivations and become prone to a closed processing mode. Meta-analyses show that anonymity, i.e., a lack of personal cues, in offline and online contexts leads individuals to act more in line with norms of their ingroup (Huang & Li, 2016; Postmes & Spears, 1998). If such norms are antisocial, this might, for example, foster hate toward outgroups and their members (Rösner & Krämer, 2016). Furthermore, selectivity in online environments makes it easier for individuals to participate in movements that are socially unacceptable in their offline community.

The special possibilities for *interaction* online can also support closed information processing. Groups strongly motivated to reach a goal tend to endorse leadership (Kruglanski et al., 2006), which can be particularly effective online. For example, hierarchy has been shown to enhance the abilities of teams playing the online game League of Legends (Kim et al., 2017). Moreover, the internet enables groups to interact more efficiently with others to achieve their goals. They can not only persuade potential ingroup members to join them (Bos et al., 2020) but also easily attack outgroups and their members with insults and threats (Brown, 2018).

Together with the potential for interaction, *interconnectedness* online may especially aid and reinforce a closed processing mode. Collective information processing depends on combinations of contributions (see above) that can work highly effectively online. Online social movements can continuously provide their members with practical information, ideological content, and support to accomplish their collective goals (Jost et al., 2018). However, strong online interconnectedness might also contribute ultimately to radicalization. A study conducted with members of neo-Nazi online forums, for instance, demonstrated that their extremism increased with participation (Wojcieszak, 2010).

Automatization on the internet may further boost a closed processing mode. Algorithms and artificial intelligence can potentially present groups with content accurately adjusted to their preexisting beliefs, including computational propaganda (S. C. Woolley & Howard, 2017). They could, thereby, support extreme forms of closed processing and lead to the spread of misinformation and polarization (Neudert & Marchal, 2019).

At the other end of the spectrum, the internet offers new possibilities for open collective information processing. Online spaces allow the *participation* of various people, including social and political minorities. As in offline contexts (Nemeth & Kwan, 1987), this may facilitate a creative, open collective processing mode. For example, gender and tenure diversity have been shown to enhance the productivity of programming teams (Vasilescu et al., 2015), and opinion diversity in online discussion forums has been shown to lead to a higher level of deliberation (Karlsson, 2012).

Selectivity may also aid open processing in groups when it hides members' attributes that might inhibit collaboration and shift the focus away from the idea itself (e.g., because of prejudices). Accordingly, a study on online brainstorming demonstrated that diverse groups who were also anonymous showed the highest level of group creativity (Garfield et al., 2007). Additionally, selectivity may help members of stigmatized groups to participate in open collective online processes. For example, anonymity has been shown to be critical in order for individuals to participate in the LGBTQ+ community and learn from each other (Fox & Ralston, 2016).

Furthermore, online tools for *interaction* can also contribute to openness in collective processes as they might help groups to generate new ideas effectively. As mentioned above, more communication in online teams correlates with higher collective intelligence—a construct including openness in brainstorming tasks, among others (Engel et al., 2014). An experiment also demonstrated that political deliberation as an open and rational communication process can be equally effective in face-to-face and online settings (Min, 2007). Regarding online interaction between groups, a study on the Israel–Palestine conflict on Facebook demonstrated that online spaces generally have the potential for open intergroup communication and prejudice reduction (Ruesch, 2013).

Interconnectedness has the potential to additionally amplify openness in collective information processing. Due to the unique possibilities for combinations of contributions (see above) on the internet, groups might be able to collaborate creatively and explore new connections. A study of individuals with diabetes, for example, showed that patient communities can generate information, advice, and empowerment for their members (Brady et al., 2017). Other examples of open-minded problem-solving are cases of online crisis management in local communities during violent attacks or natural disasters (see above; Büscher et al., 2014).

Finally, online *automatization* may foster collective open-mindedness in online spaces. Just as algorithms and artificial intelligence seem able to

draw groups further toward a predetermined direction (see above; Neudert & Marchal, 2019), they could also nudge collective creativity, reflection, and the reevaluation of preexisting beliefs.

Discussion

The previous sections systematically elaborated on how different modes of collective information processing might interact with the technical infrastructure online. Based on the MCIP (Schindler, in preparation), they referred to the distinction between (1) automatic (i.e., simple) vs. systematic (i.e., thorough) and (2) closed (i.e., determined) vs. open (i.e., open-minded) information processing on the group level. The four different processing modes were then examined against the background of (a) participation, (b) selectivity, (c) interaction, (d) interconnectedness, and (e) automatization as core technical possibilities of the internet. A first literature review based on this framework suggests that each of these factors can facilitate each collective processing mode on an entirely new level. Certainly, whether this occurs depends on group characteristics, technical configurations, and situational factors. Under particular conditions, a given processing mode might also persist or diminish, as many of the aforementioned mechanisms may counterbalance or contradict each other. However, and most important, online spaces have the potential to reinforce any four collective processing modes—with all their consequences. In the following sections I discuss the implications of this potential separately for each dimension of information processing.

Automatic vs. Systematic Processing Online

On the continuum between automatic (i.e., simple) and systematic (i.e., thorough) information processing, online spaces may, on the one hand, promote an automatic mode. In online infrastructures, groups can easily access simple-to-grasp information like heuristic cues. Thus, they need to invest even less cognitive effort than in offline contexts. However, this should not necessarily be associated with lower-quality outcomes. In some cases, of course, online spaces may amplify biases due to automatic processing. Often, however, technical assistance might contribute to higher-quality results of automatic processing. Participation of many users might, for

example, lead to better-founded majority cues and automatization to more carefully selected information.

On the other hand, online environments may accelerate systematic information processing in groups. Online spaces can assist groups to collaborate on a large scale and effectively combine their members' resources. At the same time, collective systematic information processing might require less effort online as it is partly supported by technology. Sometimes, it may fall into the trap of sophisticated misinformation, e.g., deepfakes (Dan et al., 2021). However, systematic information processing of groups might often produce even more elaborated outcomes when supported by an online infrastructure. For instance, the participation of many users might increase the number of available resources; interconnectedness may enable groups to better organize individual contributions; and automatization might help perform ideal systematical information searches.

Regarding the relationship between collective automatic and systematic information processing in online environments, both processing modes seem to be converging to some extent. Generally, automatic processing offers the benefit of low requirements but the drawback of lower-quality results, while the opposite is true for systematic processing. Online environments seem to compensate somewhat for both weaknesses simultaneously. Technical support can make the automatic parts of collective information processing more effective (i.e., lead to more accurate results) and the systematic parts more efficient (i.e., require less effort). Thus, we can assume that online environments may generally increase the elaborateness of collective information processing outcomes.

Closed vs. Open Processing Online

On the continuum between closed (i.e., determined) and open (i.e., open-minded) information processing, the internet might support a closed mode on the group level. Due to a larger sphere of influence and more and better-organized resources, groups can effectively work toward their common goals. Selectivity might, for example, increase the salience of internal group norms in relation to general societal norms; interaction may offer opportunities to recruit ingroup members or attack outgroup members; and automatization might reaffirm existing beliefs. Closed information processing is human and not harmful per se. To a certain extent, it can be functional for a pluralistic society by stimulating discourse between different camps or by allowing for reliable, shared principles (e.g., a constitution). However, depending on their design, online environments might also

fuel an extreme form of closed information processing in groups, known as group centrism (Kruglanski et al., 2006), which refers to collective processes characterized by strong group norms and pressure to conform, ingroup favoritism, and support for autocratic leaders. When associated with a high level of elaborated, systematic processing (see above), extreme closedness should be the most challenging collective processing mode for society. Via an online infrastructure, skilled and extreme groups seem particularly capable of facilitating radicalization, misinformation, hate, and polarization.

At the same time, the internet allows for more-open collective information processing. Online spaces might inspire and support groups in exploring new perspectives and solutions together. Participation may, for instance, enhance diversity; interaction may boost creativity and allow for positive intergroup contact; and automatization could challenge preexisting beliefs. Again, the design of online environments is critical to realizing these opportunities. In conjunction with systematic processing (see above), an open collective processing mode could offer the most significant potential for society. It might contribute to new dimensions of social connection, knowledge gain, empowerment, and deliberation.

Unlike the automatic vs. systematic continuum, the ends of the closed vs. open continuum seem to be moving even farther apart in online spaces. Automatic and systematic processes are driven by a trade-off between effort and benefit as their opposition is caused simply by limited resources. Closed and open processing, however, are guided by specific motivations that are inherently and fundamentally opposed to each other. Their respective mindsets, beliefs, or ideologies might become even more accentuated when they encounter specific technical infrastructures. This dynamic suggests that online environments may essentially increase the gap between closed and open collective information processing—both in terms of how they operate and what their outcomes are.

Conclusion

In this contribution I have sought to develop a theoretical perspective on how online environments shape online group processes, e.g., in e-communities, online social movements, or online discussions. Applying the propositions of the model of collective information processing (MCIP, Schindler, in preparation), I have demonstrated that a collective information processing perspective might be a helpful lens for group phenomena online. An illustrative literature review indicates that the internet can

function as a catalyst for any collective processing mode—depending on the interplay of a group, infrastructure, and situation. First, this applies to the continuum of automatic (i.e., simple) vs. systematic (i.e., thorough) processing on the group level. Due to technical support, however, both extremes seem to converge in becoming more efficient and effective at the same time. Second, online environments also seem to reinforce both ends of the continuum between closed (i.e., determined) vs. open (i.e., open-minded) processing in groups, and these appear to be drifting even farther apart on the internet. The continuum between closed and open processing, especially, appears to harbor for societies not only threats but also opportunities never before seen.

Of course, the present work has several limitations. It presents only a first draft of a theoretical framework for collective information processing in online spaces. More specifically, it can only begin to address the similarities and differences between collective processing in small, face-to-face groups and large groups online. Furthermore, the review of the connection between technical possibilities and collective processing modes is not exhaustive, and the interplay of both processing dimensions (automatic vs. systematic and closed vs. open) is only briefly discussed. Finally, the relationship between processes on the group level and on the individual level remains to be examined in greater detail. Future work should further develop and more comprehensively link this draft with existing literature, but most important, the presented framework needs to be tested empirically.

Nevertheless, the theoretical implications of the current contribution may inspire and benefit future research that focuses specifically on the group level. The most urgent issues of our time seem inseparably linked to group processes (e.g., the climate crisis, COVID-19 pandemic, or ideological polarization in general). A collective information processing perspective might, therefore, shed new light on seemingly well-researched areas. Future studies could explore questions such as the following: Under what circumstances do different collective processing modes occur in online spaces? How do groups utilize the same online infrastructure based on different processing modes? What role do algorithms and artificial intelligence play in this? How could extreme forms of closed collective information processing be attenuated? And how might online environments help collective intelligence and creativity reach their full potential? These kinds of questions are relevant not only for (social) scientists but also policymakers, platform developers, and citizens in general. Their answers could contribute to a deeper understanding of social phenomena online and, ultimately, their consequences for the offline world.

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