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The model of collective information processing (MCIP): systematicness and openness in group-level media processing

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Media information is often processed collectively—by partners, families, or peer groups—yet communication theory remains primarily focused on individuals. This article introduces the Model of Collective Information Processing (MCIP), which conceptualizes collective media processing as a group-level phenomenon. Drawing on individual information-processing theory and group research, the MCIP proposes two independent dimensions of group-level processing: systematicness (from automatic to systematic) and openness (from closed to open). The model was initially tested in a survey of 182 naturally occurring groups engaging with a media stimulus in an ecologically valid setting. Results support the distinctiveness and independence of both dimensions. Systematicness predicted persuasive attitude change and increased issue relevance at the group level; openness was associated with nondirectional attitude shifts and reduced polarization. These patterns held across issue domains (sustainability, diversity) and group types (couples, families, friends). The MCIP offers a conceptual framework for analyzing collective media processing and its effects.

KEYWORDS
collective information processing, systematicness, openness, group communication, group media processing, group-level media effects, shared media use, collective cognition

1 Introduction

People rarely process media (i.e., mass-mediated content across traditional and digital forms, e.g., newspapers, movies, or social media) in isolation. They watch, read, and react together—around dinner tables, on the living room couch, or in group chats (Gehrau, 2019; GfK, 2019; Schindler et al., 2025). In fact, half of all video viewing time takes place in the presence of others (GfK, 2019), and exchanges about media content via conversations or messaging are part of everyday social life (Gehrau, 2019; Schindler et al., 2025). Therefore, individual media use is often embedded in collective processes that go beyond the sum of their parts and shape how media content is processed. Experimental research demonstrates that groups process information differently than individuals (for an overview see Kerr and Tindale, 2004). Studies also show that collective discussions about media can, for example, influence political attitudes and even voting decisions—sometimes more so than direct exposure to the media itself (Druckman, 2004; Druckman et al., 2018). These findings underscore the importance of group processes for understanding media effects, not only on individuals but also on broader societal outcomes.

Yet despite the fundamentally social nature of media use, most theories used to study media information processing—such as the Elaboration Likelihood Model (Petty and Cacioppo, 1986) or the Heuristic-Systematic Model (Chaiken et al., 1989)—focus on the individual level. These and related dual-process models have been widely applied to understand how media messages affect outcomes such as issue interest, attitude change, and behaviors in various contexts, including politics, health, and entertainment (e.g., Bartsch and Schneider, 2014; Lang, 2006; Ping Yu, 2021). However, they conceptualize information processing as an intra-individual activity and do not model how contributions within a group combine into emergent properties of collective information processing at the group level.

Meanwhile, small group research outside of media studies has a long tradition but remains thematically fragmented and often context-specific. Studies on group information processing often focus on specific tasks (e.g., problem-solving, recall) or settings (e.g., juries, classrooms) or zoom in on particular mechanisms like information pooling or minority influence (for an overview see Beck et al., 2021). These contributions are valuable within their respective domains, but they typically explain discrete mechanisms or outcomes under defined conditions rather than integrating them under overarching processing dimensions to conceptualize how groups think across contexts and explain multiple outcomes of these processes.

This article addresses that gap by introducing the Model of Collective Information Processing (MCIP), which expands on previous conceptualizations (Schindler, 2023; Schindler and Bartsch, 2019). While the MCIP is developed and empirically examined with media content as a central empirical domain, it is not limited to this context and is intended to capture more general processes of collective information processing across group settings. Building on the idea of groups as information processors (Hinsz et al., 1997), the MCIP proposes that small groups function as systems of information processing. Specifically, it identifies two general, independent, and empirically grounded dimensions of group-level processing:

- Systematicness captures how thoroughly groups engage with information, ranging from automatic to systematic.
- Openness captures how open-mindedly groups engage with information, ranging from closed to open.

The resulting processing styles are conceptualized as situational properties of group interaction that may vary across tasks and contexts, although groups may exhibit recurring tendencies in these processing styles. The two dimensions are not new in themselves: they draw on established findings from individual-level dual- and multi-process models and prior work on group phenomena across communication, psychology, and group research. What the MCIP adds is the integration of these dimensions under a single framework for understanding collective information processing across contexts. Specifically, the key contributions of the MCIP are threefold.

First, the MCIP formulates information processing at the group level. It transfers the structural logic of dual- and multi-process theorizing to interacting groups and specifies how collective processing properties emerge from member contributions, thereby treating the group itself as the analytical unit.

Second, the MCIP conceptualizes overarching logics of group information processing with the aim of both theoretical breadth and parsimony. Its two orthogonal dimensions—systematicness and openness—organize classic group-level mechanisms like deliberation or groupthink within a coherent dimensional space. In doing so, the MCIP shows how the same outcome, such as attitude change, can emerge from distinct configurations of systematicness and openness. Furthermore, it demonstrates how multiple outcomes, such as attitude change and increased issue relevance, can be understood as related expressions of a group's processing style, rather than as isolated effects of separate mechanisms.

Third, the MCIP provides a starting point for further theorizing of group information processing in multiple directions. Because of its integrative structure, it enables the systematic investigation of antecedents that shape processing styles, characteristics through which these styles manifest, and the resulting outcomes. It could also be applied across levels, either extended to larger groups or connected to individual processes and outcomes.

The present article focuses on establishing the dimensional structure of the MCIP and examining four exemplary outcomes, laying the foundation for future theoretical and empirical extensions. It first outlines the foundations of group information processing and derives the core propositions of the MCIP from existing theory and empirical research. The article then tests associated research questions and hypotheses in a setting of high ecological validity, drawing on a survey of 182 naturally occurring small groups who discussed either a video on a sustainability or diversity topic. The results support the conceptualization of systematicness and openness as independent processing dimensions at the group level. Furthermore, they demonstrate that systematicness increases collective issue relevance and persuasive outcomes, while openness increases nondirectional attitude shifts and reduces polarization at the group level. Together, these findings underscore the core idea of the MCIP, that group-level information processing is conceptually parallel to—but procedurally distinct from—individual processing.

2 Theoretical model

This section establishes the conceptual foundations of group information processing and derives the MCIP's three core propositions regarding systematicness and openness as independent dimensions of collective information processing.

2.1 Group information processing

Humans are inherently dependent on group life, and their minds are "truly social," inseparably linked to their social environment (Caporael, 1997: 227). Social identity theory (SIT; Tajfel and Turner, 1986) posits that individuals have not only a personal identity (I vs. you) but can also internalize a social identity (we vs. them) and think as part of their group. While

SIT originally referred to large groups, it is also applicable to small groups (Hogg et al., 2004) and even dyads (Brewer and Gardner, 1996). Consequently, the MCIP defines groups minimally as "two or more people" (Williams, 2010: 269), as even dyads enable interpersonal exchange and thus collective rather than purely individual information processing. At the same time, dyads and larger groups differ in important respects (Moreland, 2010), and the influence of group size on information processing should be examined in future work. Furthermore, while the MCIP's conceptual development begins with small groups as the most elementary and well-researched human group form, its assumptions may be extended to larger groups.

Humans' social minds enable unique forms of cooperation. Hinsz et al. (1997) conceptualized groups as information-processing units, supported by extensive findings from small-group research. Collective information processing requires a minimum level of social sharedness. The concept refers to shared states and processes among group members, including information, motives, attitudes, norms, identities, cognitive processes, and emotions (Hinsz and Bui, 2023; Tindale and Kameda, 2000). Additionally, collective processing relies on combinations of contributions. Groups must identify relevant contributions of their members, such as resources, skills, and knowledge, and then interactively integrate these contributions through aggregation, linking, or transformation (Hinsz et al., 1997). Thus, information processing in groups emerges as their shared perceptions lead to collaboration. This collaboration evolves into a collective process that goes beyond the sum of individual contributions.

The collaborative dynamic gives group information processing unique characteristics compared to individual processing. First, the elements that are shared within a group—such as motives, attitudes, or emotions—can vary, shaping how collective processes unfold (Hinsz et al., 1997; Hinsz and Bui, 2023; Tindale and Kameda, 2000). Second, group processes are shaped by social influences, such as group norms, majorities, and leaders. From a group perspective, these influences are not mere confounders but are essential for maintaining group identity, unity, and functionality. In this context, conformity within groups often arises from internalized social identification rather than external pressures from others (Hinsz et al., 1997; Hogg et al., 2004; Tindale and Kameda, 2000). Importantly, the MCIP conceptualizes collective information processing as intrinsically motivated collaboration based on social sharedness and excludes interactions driven by fundamentally conflicting interests or extrinsic pressure on group members.

Despite these procedural differences, group and individual information processing share conceptual commonalities. Both involve stages such as objectives, attention, encoding, storage, and retrieval (Hinsz et al., 1997). Moreover, theoretical and empirical research repeatedly suggests processing dimensions and modes at the group level that align with those at the individual level (e.g., De Dreu et al., 2008; Kruglanski et al., 2006; Scholten et al., 2007). These parallels point to universal patterns in human information processing that transcend levels of analysis, providing a foundation for studying group processes through comprehensive frameworks. The following sections will explore how group information processing can be described through the dimensions of systematicness and openness.

2.2 Proposition 1: automatic vs. systematic processing in groups

Dual-process models have long distinguished between automatic and systematic processing at the individual level. Prominent examples include the elaboration likelihood model (ELM; Petty and Cacioppo, 1986: peripheral vs. central); the heuristic systematic model (HSM; Chaiken et al., 1989: heuristic vs. systematic); and the limited capacity model of motivated mediated message processing (LC4MP; Lang, 2006: automatic vs. controlled). Despite differences in terminology and scope, these models describe a similar continuum between automatic and systematic information processing that applies across different types of mental activities, including intellective and memory-related tasks as well as judgment (Chaiken et al., 1989; Lang, 2006; Petty and Cacioppo, 1986).

Automatic processing occurs superficially and often unconsciously with minimal effort or motivation. It enables individuals to conserve cognitive resources in a complex environment (Lang, 2006). *Systematic processing*, in contrast, is thorough and deliberate, requiring greater effort and characterized by higher motivation, breadth and depth (Chaiken et al., 1989; Lang, 2006; Petty and Cacioppo, 1986). Although systematic processing is more elaborate, it is not necessarily unbiased, as it may be guided by pre-existing beliefs or goals (Chaiken et al., 1989; Kunda, 1990). Openness is therefore introduced as a separate dimension.

Traditionally, the automatic–systematic continuum has been applied to individuals, but increasing evidence supports its relevance to groups. Some studies explicitly reference systematic processing in groups (e.g., De Dreu et al., 2008; Scholten et al. 2007), and many group phenomena implicitly reflect this dimension. The following paragraphs illustrate how collective intellective, memory, and judgmental processes vary in their degree of systematicness, with particular emphasis on their interactive, group-specific nature.

In the domain of intellective processing, research on collective intelligence shows that groups can solve complex tasks with varying levels of systematicness. Their collective intelligence depends more on collaboration than on the intelligence of individual members (Woolley et al., 2010), highlighting the need to conceptualize group processes as emergent rather than additive. In terms of memory, groups can develop transactive memory systems that vary in effectiveness and reflect more or less systematic processing (Zhou and Pazos, 2020). These systems are based on shared meta-knowledge about who knows what and on communication processes that enable collective information storage and retrieval (Wegner, 1987). In judgment, groups can, like individuals, rely on heuristics—simple but sometimes flawed decision rules associated with automatic processing (Argote et al., 1990). They can also adopt systematic approaches such as deliberation, where members collectively evaluate arguments before reaching a conclusion (Mendelberg, 2002).

These examples demonstrate how group-level processes align with the automatic–systematic continuum across multiple domains. They also underscore the collective and emergent character of this processing dimension. This leads to the first proposition of the MCIP:

Proposition 1: Collective information processing can be conceptualized on a continuum ranging from automatic to systematic processing.

2.3 Proposition 2: closed vs. open processing in groups

While less widely discussed than the automatic–systematic distinction, individual information processing can also be conceptualized along a dimension ranging from closedness to openness. This dimension is central to various frameworks, including the heuristic systematic model (HSM; Chaiken et al., 1989: high vs. low defense motivation); motivated reasoning (Kunda, 1990: weak vs. strong directional goals); and lay epistemics theory (Kruglanski et al., 2009: high vs. low need for specific closure). Despite variations in terminology and scope, these conceptualizations describe a general continuum between closed and open processing that applies across intellective, memory-related, and judgmental tasks (Chaiken et al., 1989; Kruglanski et al., 2009; Kruglanski and Webster, 1996; Kunda, 1990).

Closed processing is characterized by the selective search and recall of information and arguments to confirm predetermined outcomes (Chaiken et al., 1989; Kruglanski et al., 2009; Kunda, 1990), often driven by needs such as maintaining self-worth or reducing cognitive dissonance. In contrast, *open processing* entails a willingness to consider multiple outcomes and an open-minded handling of diverse opinions, arguments, and information (Chaiken et al., 1989; Kruglanski et al., 2009; Kunda, 1990). While open processing is not inherently more accurate, it avoids the predetermined orientation of closed processing.

Although this continuum is typically applied to individuals, theoretical and empirical evidence suggests its relevance at the group level. Explicit applications of this dimension to groups are limited (e.g., Kruglanski et al., 2006), but numerous group phenomena align with closed vs. open processing. The following examples illustrate how the closed–open continuum manifests in emergent group-level intellective, memory, and judgmental processes.

In intellective processes, research has demonstrated varying levels of group creativity (De Dreu et al., 2011). Defined as the ability to generate new ideas, solutions, or insights (De Dreu et al., 2011), creativity exemplifies open processing. For memory-related processes, the common-knowledge effect refers to the tendency of groups to prioritize information already shared among members (Lu et al., 2012), reflecting a closed processing mode. In contrast, groups can also integrate unique, unshared knowledge into the collective process (Lu et al., 2012), exemplifying a more open process. Regarding judgmental decisions, several group phenomena illustrate closed collective processing. Examples include confirmation bias at the group level (Schulz-Hardt et al., 2000) and more extreme phenomena, such as groupthink (Janis, 1982; Mullen et al., 1994) or group centrism (Kruglanski et al., 2006), which are marked by strong group norms, conformity pressure, in-group favoritism, and support for autocratic leaders. In contrast, group deliberation exemplifies open judgment, characterized by an unbiased evaluation of arguments (Mendelberg, 2002).

Together, these examples show that the closed–open continuum applies across domains of collective processing. They also highlight the group-specific dynamics that give rise to openness or closedness. These insights underpin the second proposition of the MCIP:

Proposition 2: Collective information processing can be conceptualized on a continuum ranging from closed to open processing.

2.4 Proposition 3: independence of systematicness and openness

After introducing systematicness and openness as processing dimensions, their interrelation requires further clarification. Once again, an analogy from individual information processing is useful. Although automatic processing is sometimes equated with closed processing and systematic processing with open processing, research has demonstrated that these dimensions are independent. This means that automatic processing can be open to any result (Forgas, 1995), whereas systematic processing can be biased toward achieving a specific goal (Chaiken et al., 1989; Kunda, 1990). Some models of individual information processing explicitly include closedness as a dimension (e.g., Chaiken et al., 1989: defense motivation Kunda, 1990;: directional goals). Forgas's (1995) affect infusion model (AIM) illustrates the independence of these dimensions by combining processing modes akin to automatic, systematic, closed, and open processing. The AIM distinguishes between low or high elaboration and low or high affect infusion, defined as openness to affectively charged information. It identifies four possible combinations of these modes: direct access (low elaboration, low infusion), heuristic processing (low elaboration, high infusion), motivated processing (high elaboration, low infusion), and substantive processing (high elaboration, high infusion) (Forgas, 1995).

The AIM (Forgas, 1995) provides an individual-level reference point for the MCIP. Whereas the AIM conceptualizes the interplay of processing dimensions within individuals, the MCIP transfers this logic to the group level by modeling the interplay of systematicness and openness in collective information processing. The following analysis simplifies the continua into categorical modes (automatic vs. systematic, closed vs. open) and explores all possible combinations as forms of emergent collective processing, illustrated with examples from group research. Evaluating whether these configurations are conceptually coherent and empirically observable at the group level provides an initial step toward testing their orthogonality. Judgmental processes were chosen as an example for three reasons. First, they are foundational to (collective) opinion formation, making them particularly relevant to communication research. Second, they are highly influenced by group dynamics, such as conformity to group norms (Kaplan and Miller, 1987). Third, judgmental processes are broadly applicable because they inherently involve intellective and memory-related elements (Kunda, 1990).

The first processing mode, *retrieval*, represents a combination of automatic and closed information processing in groups and corresponds to Forgas's (1995) concept of direct access at the individual level. This mode occurs when a group bases its collective judgment on information already shared and stored among its members. A typical example is the common knowledge effect, in which shared information disproportionately influences collective judgment, resulting in a simple process with a predetermined outcome.

In contrast, the second processing mode, *heuristics*, combines automatic and open processing. This mode parallels Forgas's (1995) heuristic processing at the individual level. This applies when groups use simple decision rules to reach a new judgment. The prototypical case is a group using heuristics to form collective judgments (Argote et al., 1990), demanding little cognitive effort without a predetermined outcome.

The third processing mode, *confirmation*, reflects closed and systematic processing and aligns with Forgas's (1995) motivated processing at the individual level. This mode is characterized by collective efforts to achieve a shared and predetermined judgmental goal. A prime example is confirmation bias in group judgments (Schulz-Hardt et al., 2000), which requires high levels of elaboration while being selectively driven by a specific outcome.

The final processing mode, *deliberation*, combines open and systematic processing and corresponds to Forgas's (1995) concept of substantive processing at the individual level. It involves thorough and open-minded group debate to reach collective judgments. Group deliberation is a prototypical example of this mode (Mendelberg, 2002), requiring mental effort while allowing for open-ended outcomes.

The four prototypical configurations of automatic vs. systematic and closed vs. open collective information processing are summarized in Table 1, which illustrates the orthogonality of systematicness and openness as group processing dimensions at the theoretical level. This understanding is captured in the third and final proposition of the MCIP:

Proposition 3: Systematicness and openness represent two independent dimensions of collective information processing.

3 Empirical questions and hypotheses on group processing dimensions and their effects

The three core propositions of the MCIP—the existence of the collective processing dimensions of (1) systematicness, (2) openness, and (3) their independence—have been developed based on the literature but remain to be empirically tested in groups. This section introduces the research questions and hypotheses designed to evaluate the core ideas of the MCIP.

First, Propositions 1 and 2 raise the question of whether the dimensions of automatic vs. systematic and closed vs. open information processing can be empirically distinguished in groups:

TABLE 1 Four prototypical modes of judgmental processes at the group level.

Systematicness	Openness	
	Closed	Open
Automatic	*Retrieval* Collective judgment based on group members' shared and stored information.	*Heuristics* Collective judgment based on simple decision-making rules.
Systematic	*Confirmation* Collective judgment driven by efforts to reach a shared and predetermined goal.	*Deliberation* Collective judgment based on thorough and open-ended debate.

RQ1: Can information processing in groups be described along the distinct dimensions of (a) systematicness and (b) openness?

Proposition 3 leads to the hypothesis that these dimensions are independent:

H1: Systematicness and openness represent empirically independent dimensions of collective information processing.

Beyond establishing the dimensions themselves, it is essential to examine how variation in systematicness and openness shapes collective outcomes. Drawing from individual- and group-level research, this study examines two constructs central to communication research: attitude change and issue relevance.

At the individual level, systematic processing typically leads to stronger persuasive attitude changes due to deeper engagement with messages and their arguments (Chaiken et al., 1989; Lang, 2006; Petty and Cacioppo, 1986). Similarly, group discussions characterized by elaborate reasoning facilitate attitude change among members (Esterling et al., 2021; Westwood, 2015). Additionally, systematic processing enhances perceived issue relevance, as demonstrated by studies showing that in-depth discussions heightened awareness (Rojas et al., 2005) and the perceived importance of media topics (Haas, 2014). Extending this logic to group-level processing, it can be hypothesized that collective systematic processing facilitates both collective persuasive attitude change and increased collective relevance assessments:

H2: Higher systematicness in collective information processing is associated with (a) greater persuasive attitude change and (b) increased issue relevance at the group level.

Open processing, defined by receptiveness to diverse arguments and information, fosters nondirectional attitude change in individuals (Chaiken et al., 1989; Kruglanski et al., 2009). Similarly, deliberative group discussions have been shown to facilitate attitude shifts among members across ideological divides (Gastil et al., 2008).

In contrast, low levels of openness are associated with either maintaining existing attitudes or shifting toward more extreme versions due to a selective focus on particular arguments and information (Chaiken et al., 1989; Kruglanski et al., 2009; Kunda, 1990). Group research has echoed this pattern, showing that like-minded discussions can result in group polarization, producing more extreme attitudes among members (Strandberg et al., 2019). This process can be traced back to social comparison processes and persuasive argumentation (Isenberg, 1986).

Consequently, it is hypothesized that higher levels of open collective processing promote nondirectional attitude changes and reduce polarization at the group level:

H3: Higher openness in collective information processing is associated with (a) more nondirectional attitude change and (b) reduced attitude polarization at the group level.

4 Methods

To empirically test the propositions of the MCIP, joint media use was selected as a typical, relevant, and empirically accessible case of collective information processing. It is not only highly prevalent in everyday life and associated with important outcomes, as outlined in the introduction, but also particularly

suitable for empirical investigation, as shared media exposure can be readily induced in controlled yet naturalistic settings. To ensure high ecological validity, the study focused on natural groups—couples, families, and friends—who commonly process media information together in everyday life (GfK, 2019). These groups bring preexisting social sharedness as a fundamental prerequisite for collective information processing. They also vary in characteristics, such as group size and type, enabling the identification of overarching patterns in collective information processing.

Because the MCIP conceptualizes groups as entities that transcend the sum of their members, collective processes were measured directly at the group level. A standardized online group survey was employed, in which groups completed the questionnaire jointly. Although behavioral observations are a common approach for studying group processes, they are less feasible for large samples of natural groups in ecologically valid settings. The principle of standardized group responses is well established in organizational research, where convergent, discriminant, and predictive validity have been demonstrated (e.g., Gibson et al., 2000; Kirkman et al. 2001,; Quigley et al., 2007). Extending this logic to a full questionnaire format, the group survey offers a scalable means of systematically studying collective processes in large samples of natural groups (Schindler, 2025). While standardized group responses have been validated in prior research, embedding them in a comprehensive online survey format is relatively novel. Accordingly, several pretests and safeguards were implemented to support measurement validity (see below). By examining theoretically grounded relationships based on general principles of information processing, the present study also contributes to further validating the group survey approach by testing its nomological validity (Schindler, 2025).

To examine the effects of group processes, a pre-post design was employed. Rather than experimentally manipulating processing modes, this approach captures group information processing as it naturally occurs, while still allowing for cautious causal inference. It strikes a balance between ecological validity and internal validity.

4.1 Sample

The groups were recruited via individual members of an online panel in Germany.[1] The panel contact person received monetary compensation for participation. As an additional group incentive, all members could enter a lottery for €25 vouchers upon survey completion. The final sample consisted of 182 groups (438 individuals in total). Group sizes included two members (68.7%), three members (22.0%), and four members (9.3%). Group types comprised partners (35.7%), family members (41.7%), and friends (22.5%). These group sizes and types reflect typical constellations of shared video viewing (GfK, 2019). Sociodemographic characteristics were calculated at the group level (e.g., the mean age per group). On average, groups had a mean age of 38.5 years ($SD = 12.4$), a mean proportion of women of 0.56 ($SD = 0.24$), and a mean proportion of members with a university degree of 0.31 ($SD = 0.37$). The remaining members had completed secondary education (including lower and intermediate levels), vocational training, or were still in school.

[1]The groups were recruited between June and November 2020. As it was difficult to recruit groups of friends during the COVID-19 pandemic, 14 groups also were recruited via indirect personal contacts. Their sociodemographic characteristics and attitudes toward the stimulus topics varied widely, implying that this additional recruitment strategy did not lead to confounding between group type and other characteristics.

4.2 Procedure

The groups completed an online questionnaire together using a single device (see the supplementary material for all measures). The survey was developed with SoSci Survey (Leiner, 2019). Each question could be answered with a shared response or with the option "we are not united," ensuring that the responses captured collective perceptions and attitudes (Schindler, 2025).

Groups first received information about the study procedure, including its purpose, anonymity, and data usage. Participants then decided whether to proceed. Upon providing informed consent, groups were randomly assigned to one of two controversial topics: a sustainability topic ("car-free cities," $n = 105$ groups) or a diversity topic ("same-sex parenting," $n = 77$ groups). This variation allowed for the identification of general information-processing patterns across different conditions. Next, the groups responded to questions assessing their initial collective issue relevance and attitudes toward the assigned topic. They then watched a related video stimulus and engaged in a natural discussion about it for at least two minutes. This discussion served as a collective information-processing episode that could be easily recalled and reported. The two-minute minimum was intended to prompt spontaneous interaction without triggering resistance that might arise from a longer mandatory discussion. Subsequently, the groups responded to items assessing the systematicness and openness of their conversations. Collective issue relevance and attitudes were measured again to detect any changes resulting from the discussion and video stimulus. Finally, each group member provided sociodemographic data. To verify consensus on group responses, individual members completed a follow-up survey 24 h later (see the supplementary material).

4.3 Pre-study and data quality

Because the group-survey procedure used to measure systematicness and openness was relatively new, it was pilot-tested before the main data collection (Schindler, 2023, 2025). The pre-study was not intended as a standardized validation study, but to troubleshoot the procedure, examine whether collective responses emerged from group interaction, and obtain exploratory indications of whether the self-reports were broadly consistent with observable discussion behavior. In groups, communication makes information processing visible enough to assess these patterns qualitatively. Eight natural groups participated without a researcher present. Their discussions were recorded, transcribed, and analyzed using qualitative category

coding. Categories were developed in a deductive–inductive manner, informed by the theoretical constructs and iteratively refined based on the data. Coding was conducted at the group level, focusing on sequences of collective response decisions (e.g., initial agreement, agreement strategies such as arguments or majority), and included indicator passages for systematicness (e.g., explicit justification and elaboration of arguments) and openness (e.g., explicit engagement with and consideration of differing viewpoints). Given the qualitative and process-oriented nature of the analysis, coding was conducted by the author, iteratively refined through discussion with other scholars, and interpreted as indicative rather than objective evidence.

First, regarding the emergence of collective answers, the transcripts suggested that shared responses usually resulted from initial agreement or negotiation processes, often through argument exchange or majority rules, rather than being imposed by dominant voices (for details, see Schindler, 2023, 2025). Second, the survey responses were compared with observable group behavior during and after stimulus exposure to assess whether they were consistent in terms of general patterns rather than exact scale points. In most cases, responses to the systematicness and openness items were broadly consistent with the transcript evidence, for example when groups visibly exchanged arguments or engaged with different viewpoints. A few discrepancies may have reflected misunderstandings that were later clarified in the questionnaire or social desirability effects (for details, see Schindler, 2023).

Furthermore, rigorous data screening was applied after data collection to ensure that the final sample included only groups that participated seriously and collectively rather than cases where individuals completed the survey alone. This step was particularly important given the combination of limited control over the participation situation and relatively high incentives. Based on multiple predefined criteria, 177 cases were excluded (for details, see the supplementary materials and Schindler, 2023).

Finally, follow-up checks embedded in the individual survey assessed whether participants independently confirmed agreement with their group's responses without extrinsic pressure. This does not aim to eliminate group influence as such, but to ensure that the collective process was based on members' intrinsically motivated collaboration and adaptation, consistent with the MCIP's conceptualization of collective information processing. With a 77.4% response rate, 95.9% of participants affirmed genuine consensus, and two groups were excluded due to explicit disagreement with the group responses.

4.4 Video stimuli

The two video stimuli—on "car-free cities" and "same-sex parenting"—were five-minute clips from the German knowledge show "W wie Wissen". The clips were embedded directly into the group survey environment and presented without any platform-related features (e.g., view counts or comments), ensuring that no external social signals influenced participants' perceptions. Both clips were selected to elicit diverse processing styles, as they presented their topics from multiple angles, combining factual background information with personal exemplars. In tone, each clip expressed a generally favorable view of its topic, potentially prompting different responses across groups with different attitudes. Topic selection was informed by a pretest with 201 individuals, which confirmed that both issues were associated with relatively divergent prior attitudes. In addition, both videos produced modest attitude shifts, suggesting their suitability as stimuli.

The "car-free cities" clip introduced the concept and potential benefits of car-free urban areas, featuring a family and a long-term resident from such neighborhoods, along with a transportation expert advocating for gradual implementation.

The "same-sex parenting" clip highlighted that children in rainbow families can develop just as well as those in traditional families. It portrayed two families and referenced scientific evidence supporting positive developmental outcomes in same-sex parent households.

4.5 Measures

In line with the group survey approach (Schindler, 2025), all measures reported below addressed the groups as a whole. The groups could choose either a collective reply or "we are not united" when consensus was not reached. For some questions, members were then able to answer individually (see the supplementary material for each measure). The questionnaire was administered in German; all items are translated for reporting.

4.5.1 Systematicness

The items used to measure systematic processing were adapted from individual-level self-reported measures (Cacioppo et al., 1986; Reynolds, 1997; Schemer et al., 2008), with adjustments to reflect group-specific dynamics and the communicative nature of collective information processing (e.g., "We have discussed extensively," see Table 2, Items 1–4, and the supplementary material). They were selected to reflect core attributes of systematic processing—namely motivation, breadth, and depth (Chaiken et al., 1989; Lang, 2006; Petty and Cacioppo, 1986)—and were refined through eight focus groups in the pre-study (for details, see Schindler, 2023). The items were rated on a seven-point scale (1 = *strongly disagree* to 7 = *strongly agree*). Ratings were only analyzed if all group members agreed on one assessment of the group process. Responses of "*we are not united*" were coded as a missing value, as no consistent assessment across members was available (1.1%–2.2%). The results section documents a systematicness index developed based on these four items to address *RQ1a* ($\alpha = 0.76$; $M = 5.00$; $SD = 1.21$).

4.5.2 Openness

Openness was developed and measured analogously to systematicness. Given the limited availability of prior measures, six new items were constructed [e.g., "We almost always agreed in our conversation" (inverted), see Table 2, Items 5–10, and the supplementary material; not united: 0.0%–3.8%]. These items were designed to capture open-mindedness toward diverse opinions, arguments, and information—key features of open processing (e.g., Chaiken et al., 1989; Kruglanski et al., 2009; Kunda, 1990)—and were refined in the same eight focus group

TABLE 2 Factor loadings for items designed to measure systematicness and openness in collective information processing.

Item	Systematicness	Openness
1. We have discussed extensively.	**0.78**	−0.06
2. We discussed some aspects in particular depth.	**0.75**	−0.06
3. Certain points were particularly important to us in the conversation.	**0.71**	−0.15
4. We had little need to talk (R).	**0.51**	0.27
5. We almost always agreed in our conversation (R).	−0.06	**0.89**
6. We repeatedly had different opinions and discussed them.	0.15	**0.76**
7. We mainly talked about points that support our opinion (R).	−0.22	**0.53**
8. We exchanged arguments for one side as well as for the other.	**0.62**	0.31
9. Each of us already knew most of the things we talked about (R).	−0.12	**0.44**
10. We learned many new things through the conversation.	**0.42**	0.12
Eigen value	2.58	2.06
Percentage of variance explained	26	21

$N = 182$ groups. Factor loadings > 0.40 are in bold. Reverse-scored items are denoted with an (R). Scale: 1 = *strongly disagree* to 7 = *strongly agree*; residual option: *we are not united*.

discussions. The final openness index included four items and is described in the results section in response to *RQ1b* ($\alpha = 0.73$; $M = 2.79$; $SD = 1.53$).

4.5.3 Issue relevance change

Issue relevance was operationalized using a single item asking how important the respective topic was to the group (see the supplementary material). Responses were rated on a seven-point scale (1 = *not important at all* to 7 = *very important*). If the groups were not united (20.8–21.0%), their members could answer individually, and their responses were averaged to a group-level score, as they still meaningfully represent the overall group tendency (car-free cities: $M = 4.55$, $SD = 1.67$; same-sex parenting: $M = 5.15$, $SD = 1.58$). Relevance was assessed before and after the video stimulus and discussion to capture possible shifts due to the collective process. The change score was calculated as the difference between post- and pre-stimulus measures, with a positive value indicating increased issue relevance (car-free cities: $M = 0.56$, $SD = 1.33$; same-sex parenting: $M = 0.36$, $SD = 1.17$).

4.5.4 Attitude change and polarization

The groups' attitudes were measured using two items specific to each topic before the video stimulus was shown (e.g., "Cities should be car-free" or "Same-sex couples should be allowed to have children"; see the supplementary material). The items were pretested together with the stimuli. Responses were rated on a seven-point scale (–3 = *strongly disagree* to 3 = *strongly agree*), with an additional "no opinion" option. Negative scores indicated a conservative stance, positive scores a progressive stance, and zero a neutral position. If the group selected "we are not united" (9.5–11.7%), individual responses were averaged to a group mean. A topic-specific index was then computed from the two items (car-free cities: $r = 0.84$, $p < .001$, $M = –0.18$, $SD = 1.83$; same-sex parenting: $r = 0.82$, $p < .001$, $M = 1.66$, $SD = 1.69$).

Group attitudes were assessed both before and after the video and discussion. Persuasive attitude change was calculated as the signed difference between post- and pre-stimulus ratings, with a positive score indicating a progressive shift (car-free cities: $M = 0.38$, $SD = 0.95$; same-sex parenting: $M = 0.21$, $SD = 1.01$). The absolute value of this score captured the magnitude of nondirectional attitude change (car-free cities: $M = 0.69$, $SD = 0.75$; same-sex parenting: $M = 0.51$, $SD = 0.89$). Polarization was operationalized as the extent to which post-discussion attitudes became more or less extreme compared to the baseline. A positive score indicated a more extreme attitude, while a negative score reflected depolarization (car-free cities: $M = 0.06$, $SD = 0.48$; same-sex parenting: $M = –0.03$, $SD = 0.57$).

5 Results

To answer *RQ1*—whether collective information processing can be characterized by the distinct dimensions of systematicness and openness—an exploratory factor analysis was conducted (EFA; method: principal axis factoring) with the ten respective items (see Table 2 for all items and factor loadings; Table 4 in the supplementary material shows a correlation matrix). An oblique rotation method (oblimin) was chosen to avoid artificial orthogonality and empirically assess the relationship between the two dimensions. A scree plot revealed two distinct factors representing systematicness and openness of collective information processing that together explained 46% of the variance. A separate analysis for each video stimulus (car-free cities vs. same-sex parenting) yielded similar results, indicating that the factor structure was independent of the topic.

Consistent with the theoretical assumptions, items 1–4 loaded primarily on systematic processing (see Table 2). They covered breadth (1), depth (2), motivation of group information processing (3), and a combination of these aspects (4). Cronbach's alpha indicated good internal consistency ($\alpha = 0.76$). These results suggest that collective information processing can be meaningfully characterized as more or less systematic (*RQ1a*). Thus, for further analysis, a mean index was calculated, with high values indicating a high level of systematicness in the group process ($M = 5.00$; $SD = 1.21$).[2]

Items 5–10 were developed to measure openness in collective processing, focusing on open-mindedness toward different opinions (5–6), arguments (7–8), and information (9–10). However, Items 8 and 10 primarily loaded on systematicness rather than openness, likely due to their wording ("exchanged arguments," "learned many new things"), which also reflects

[2]The mean index was calculated only if values for at least three items were present.

systematic elements. The remaining items—5, 6, 7, and 9—loaded primarily on openness (see Table 2) and formed a reliable index ($\alpha = 0.73$). These results suggest that group information processing can also be meaningfully described in terms of its openness (*RQ1b*). All four items were used to calculate a mean index, with items 5 and 6 reflecting open-mindedness toward different opinions, the core of open information processing. Again, higher values indicate greater openness in the group process ($M = 2.79$; $SD = 1.53$).[3]

To test the independence of the two processing dimensions, as predicted by *H1*, their correlation was examined. Consistent with the EFA results, the dimensions were uncorrelated ($r = 0.002$, $p = .983$), supporting *H1*.

To examine the effects of systematic (vs. automatic) and open (vs. closed) collective information processing hypothesized in *H2* and *H3*, four linear regression models were estimated (see Table 3; method: ordinary least squares). In all models, the systematicness and openness of the group process served as independent variables to assess their respective effects. All models also controlled for group characteristics and stimulus topic. Model 1 showed that higher levels of systematicness were significantly associated with a persuasive attitude change at the group level, as predicted by *H2a*. Model 2 confirmed that systematic processing led to a significant rise in collective issue relevance, supporting *H2b*. Model 3 demonstrated a significant positive relationship between openness and a nondirectional attitude change at the group level, in line with *H3a*. Model 4 showed a significant negative impact of openness on group polarization, indicating that closed processing fosters polarization, as expected under *H3b*. No other predictor or control variable showed a significant effect, except in one case: in Model 4, the topic "same-sex parenting" was associated with significantly greater group polarization than "car-free cities."

6 Discussion

This article introduced the Model of Collective Information Processing (MCIP), which integrates insights from small-group research with individual-level information-processing models. The MCIP conceptualizes small groups as distinct systems of information processing and rests on three core propositions: (1) groups can vary in their degree of systematicness, ranging from automatic to systematic processing; (2) they can vary in openness, ranging from closed to open processing; and (3) these two dimensions are independent. This dual-dimensional framework brings together a wide range of group phenomena under two integrative, empirically grounded dimensions. It mirrors key conceptual features of individual-level information processing while highlighting the procedural distinctiveness of group-level processes. Despite their normative associations, both dimensions are treated as descriptive: systematicness and openness are not inherently positive or negative, though their outcomes may be socially desirable or undesirable depending on the context.

A survey of 182 naturally occurring small groups discussing controversial video content provided the first empirical test of the MCIP. An exploratory factor analysis supported the assumption that systematicness and openness constitute two distinct dimensions (*RQ1*), operationalized through two internally consistent four-item indices that were statistically independent (*H1*). Systematicness was characterized by motivated, broad, and deep engagement in the group discussion. It was positively associated with persuasive attitude change (*H2a*) and increased issue relevance (*H2b*) at the group level. Openness reflected receptiveness to diverse opinions, arguments, and information within the discussions. It correlated with nondirectional attitude change (*H3a*) and reduced polarization (*H3b*) at the group level. These effects held across both topics—car-free cities and same-sex parenting—and were consistent across different group types. Together, these findings support the three theoretical propositions of the MCIP and illustrate how systematicness and openness shape core attitudinal outcomes of group-level information processing. The observed patterns align with processing mechanisms identified at the individual level, pointing to overarching characteristics of human thinking that extend into the collective domain. They also support the nomological validity of the group survey approach by demonstrating its ability to detect theoretically grounded relationships at the group level (Schindler, 2025).

Interestingly, the groups tended toward systematic rather than automatic processing, but also toward closed rather than open engagement. While everyday situations often trigger automatic processing (Petty and Wegener, 1999), the academic setting and reflective task may have promoted greater systematicness. In contrast, the tendency toward closed processing may reflect a broader human tendency to confirm prior beliefs (Kunda, 1990), possibly intensified by pre-existing attitudes toward the selected topics.

At the same time, this initial test comes with several limitations. The study relied on self-reports of short sequences of collective information processing, focused on two issue domains, and included only specific types of small groups from a single national context. Like all self-report measures, group survey responses may be influenced by social desirability—for example, groups may have overemphasized systematic engagement. Nonetheless, the observed variance and theoretically consistent patterns suggest that such biases do not drive the main results. Future research should incorporate different methods (such as behavioral observations), longer interaction sequences, and a broader range of contexts and group types. While the indices for systematicness and openness showed good internal consistency, they should be further refined and validated across contexts. In addition, experimental designs could address the observed asymmetries—namely, the overall tendency toward systematic but closed processing in this ecologically valid setting—and provide stronger tests of causality between processing styles and group-level outcomes.

7 Implications

Groups have always been, and continue to be, a fundamental form of human social organization (Caporael, 1997). The Model

[3]The mean index was calculated only if values for at least three items were present.

TABLE 3 Regression models showing the impact of systematicness and openness in collective information processing on group-level outcomes (unstandardized coefficients, mean-centered predictors).

Model components	Model 1 Persuasive attitude change	Model 2 Issue relevance change	Model 3 Nondirectional attitude change	Model 4 Polarization
Intercept	−0.64	−1.42	−0.15	−0.06
Systematicness	0.11*	0.19*	0.06	0.00
Openness	0.07	0.08	0.13**	−0.11*
Controls				
Group type: friends	−0.21	−0.32	−0.17	0.15
Group type: couple	0.13	0.35	−0.01	−0.09
Group size	0.11	0.30	0.10	0.01
Topic: same-sex parenting	−0.02	−0.11	−0.20	0.36**
R^2	0.053	0.081	0.106	0.090

The reference category for group type is "family." *$p < .05$. **$p < .01$.

of Collective Information Processing (MCIP) offers a theoretical framework for understanding how small groups collaboratively engage with information. The observed parallels between individual- and group-level processing suggest that the model captures general principles of human thinking. By transferring established dimensions to the group level and combining them into a coherent, dual-dimensional structure, the MCIP enables new ways of conceptualizing collective information processing. The following outlines three avenues for applications and further development based on the MCIP's key contributions highlighted in the introduction.

First, by accounting for social sharedness and the combination of member contributions, the MCIP helps examine the emergent thinking of groups as a whole. It may help illuminate group processes across different contexts, such as a group of friends radicalizing collectively based on media content, a team of colleagues developing work-specific media literacy, or a family shaping collective wellbeing through joint media use. While the MCIP was developed to explain the processing of media content, it may also be applied across other group settings.

Second, by combining systematicness and openness to conceptualize general processing styles, the MCIP transcends single mechanisms and shows how different groups may process the same information differently depending on the situation. Similar levels of one dimension (e.g., systematicness) can produce different outcomes depending on the other (e.g., openness), while different configurations of both dimensions can lead to similar outcomes through distinct processing pathways (e.g., attitude change). Moreover, the MCIP considers how a group's processing style can simultaneously shape multiple outcomes such as emotions, identities, attitudes, and motivations. For example, in the case of friends jointly radicalizing through shared media engagement, the MCIP predicts that groups low in openness in a given situation would be primarily susceptible to already like-minded content, whereas groups high in openness in that situation should remain receptive to messages from multiple directions. Within these conditions, highly systematic groups would engage deeply with arguments, whereas low-systematic groups may process more superficially or require motivational triggers to shift toward systematic engagement. Depending on this configuration, groups may develop different combinations of affective, cognitive, and motivational responses explaining whether and how they radicalize collectively.

Third, by focusing on general patterns of human and collective information processing, the MCIP can be extended to capture additional aspects of group information processing. Such extensions could include antecedents like group size, attitude distribution and extremity within a group, further process characteristics, such as interaction patterns and the influence of group leaders, and further outcomes, such as knowledge (Schindler, 2023). Beyond this horizontal extension, the MCIP's logic could also be transferred vertically to higher-level groups. It may be tested in long-term interactions and larger group settings, including online group environments. As elaborated elsewhere (Schindler, 2022), core affordances of digital environments—such as participation, selectivity, interaction, interconnectedness, and automatization—may function as catalysts that amplify or constrain collective processing modes. At the same time, collective information processing can also be linked back to individual members, as understanding group-level dynamics may help to better explain individual processes and outcomes within their social context.

Taken together, these avenues illustrate how the MCIP offers an integrative framework for understanding meso-level group dynamics and linking them with micro-level individual processes and macro-level societal outcomes.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

Ethical approval was not required for the study involving human samples in accordance with the local legislation and

institutional requirements because the procedure involved minimal risk and did not fall under mandatory ethics review requirements. All participants provided electronic informed consent to participate in this study, and for participants under 18 years of age, electronic informed consent was also obtained from their legal guardians.

Author contributions

JS: Conceptualization, Methodology, Investigation, Formal analysis, Data curation, Project administration, Writing – original draft, Writing – review & editing.

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Conflict of interest

The author(s) declared that this work was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The author(s) declared that generative AI was used in the creation of this manuscript. During the preparation of this work, I used ChatGPT (OpenAI) and Perplexity for language improvement and to support the clarity and coherence of my argumentation. After utilizing this tool, I thoroughly reviewed and edited the content as necessary and take full responsibility for the final content of the published article.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fcomm.2026.1699715/full#supplementary-material

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