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Medium and source convergence in crisis information acquisition: Patterns, antecedents, and outcomes

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Abstract
To understand how individuals navigate the complex, dynamic, and bewildering media information environment, we propose a convergence framework theorizing individuals' acquisition of information from distinct sources on multiple mediums, along with its antecedents and consequences. This study is among the first to test the convergence framework. Using a national sample during the COVID-19 pandemic, our results revealed four convergence patterns and key antecedents and outcomes of these patterns. Individuals' information verification tendency, perceived medium anonymity, and trust in alternative sources were associated with distinct patterns of convergence, which led to different risk perceptions. Future research should explore different forms of convergence and additional antecedents and outcomes of convergence.

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A proliferation of social media platforms, technologies, and diverse information sources—mainstream or alternative—has significantly shaped the information landscape. The information environment individuals find themselves in becomes increasingly multimedium, multimodal, and multisource. Traditional concepts in information acquisition and crisis communication, such as the repertoire approaches (Kim, 2016) or the social-mediated crisis communication (SMCC) model (Liu et al., 2016), lend helpful insights, but the magnitude and complexity of the modern high-choice media environment warrant a more comprehensive and ecological theoretical framework to examine individuals' simultaneous consumption of information from distinct types of sources on different platforms (i.e. convergence), particularly in a crisis situation where information needs heighten.

To navigate a saturated, dynamic, and bewildering crisis information environment, individuals demonstrate unique informational behaviors beyond seeking and sharing. Convergence refers to individuals' simultaneous consumption of information from multiple mediums and sources (Anthony and Sellnow, 2016; Jenkins, 2006). Prior studies have supported the role of media convergence in daily media consumption (Yuan, 2011) and the importance of source convergence in crisis information sense-making (Anthony and Sellnow, 2016). However, it is still unknown whether different patterns of convergence exist and how different antecedents, like personal motivations (e.g. information verification tendency), affordances, and trust in alternative sources, drive convergence patterns. For example, an individual may prefer alternative sources rather than official sources and primarily use digital platforms to seek "alternative facts." Another individual with high information verification tendency could use as many sources (both official and alternative) and mediums (print media, and digital media) as possible to check the veracity of the sought information. These distinct patterns of convergence could lead to different perceptual and behavioral outcomes.

The purpose of this study is to understand and examine what convergence patterns emerge, how antecedents drive different convergence patterns, and how convergence patterns relate to different outcomes in a crisis. To that end, we propose a convergence framework that emphasizes the lived experience of convergence in the multimedium and multisource emergency information environment by recognizing that individuals' experiences with risks can be subjective, socially constructed, and shaped by their chosen combinations of mediums and sources. Specifically, individuals' demographics and personal motivations first affect how exposure to the information environment manifests into their convergence patterns. Individuals' convergence patterns can then be affected by affordances (e.g. how interactive certain mediums are) and trust in alternative versus official media. Finally, different convergence patterns can result in different risk perceptions and risk-related behaviors.

This study is the first to systematically test the convergence framework. Using a US national sample ($N=620$), we profiled distinct patterns of convergence during the

COVID-19 pandemic and revealed key antecedents and outcomes of these convergence patterns. Results from this study suggest that scholars and practitioners should recognize the ubiquity of convergence in crisis information acquisition and further study the roles of convergence in crisis information acquisition and protective behavior adoption.

Convergence defined

Convergence is defined as a phenomenon involving the merging flow of information from various sources on different mediums (e.g. print media, social media) in a combination of modalities (visual, text, and audio). The concept reflects the reality that people, living in a complex information environment, rely on a multitude of information to manage uncertainties and interpret risks (Anthony et al., 2013). Adding to the complexity, the emergency information environment typically involves a mix of information, misinformation, and disinformation, which are propagated in the digital media ecology and interact to impact people's beliefs and perceptions. Thus, it is crucial to move beyond an isolated approach; develop a better understanding of convergence; and investigate the roles of convergence in constructing individuals' lived experiences with situations related to risks.

The convergence framework proposed in this article can be traced back to the notion of media convergence. Media convergence refers to the merging flow of communication across multiple mediums (Jenkins, 2006). In its initial proposal, Jenkins (2006) focused more on the technological shift from traditional media to new media made possible by emerging digital technologies and the Internet. The emergence of this approach to understanding users' media usage is necessitated by the reality that new media never fully replace old media. New technologies complicate and add new ways of information transmission. Media convergence, as a result, examines how mediums intersect in people's daily lives to create and alter shared experiences.

Though media convergence focuses more on the flow of information across mediums, convergence, broadly speaking, is not only restricted to mediums. Convergence can also take different forms, including but not limited to messages, technologies, platforms, modalities, and experiences. The convergence framework proposed in this study considers convergence as a lived experience of individuals in a complex, multifaceted information environment. This environment is characterized by the accessibility of a mass amount of information and collision of competing sources that provide a plethora of official, unofficial, unverified, and problematic content, such as misleading or even false messages. Individuals are nested within this complicated environment, while connected with each other through relationships or interactions.

Convergence framework

As mentioned earlier, the proposed convergence framework examines how convergence patterns emerge across the dimensions of source and medium, and also examines the antecedents and consequences of convergence during a crisis, providing a fuller view of the convergence phenomenon. Each dimension is described in detail below, as is the combined convergency of source and medium type. We define mediums/media as both

ways of information transmitted (e.g. print media, digital media, and social media; similar to channels) and types of information transmitted (e.g. news media, sports media) in this study.

Source. Individuals rely on various sources to acquire information necessary to have a complete understanding of risks and issues. According to message convergence theory (MCT), people look for consistent patterns among information provided by different sources to develop better understanding of their risks and gain a complete picture of the situation (Anthony and Sellnow, 2016). According to MCT, people typically receive messages from various sources with different views on an issue. These messages are conflicting but are "not often completely incompatible" (Anthony et al., 2013: 348). To comprehend the messages, those involved in a disaster tend to go through points of overlap between messages to evaluate the veracity of messages. A growing line of studies has examined MCT in disaster and crisis communication (Anthony et al., 2013; Herovic et al., 2014; Sellnow et al., 2019). For example, Anthony and Sellnow (2011) examined people's perceived convergence of traditional media (i.e. television, radio, and newspaper) outlets during Hurricane Katrina.

With the growth of alternative news sources, individuals can seek information on social media not only from traditional, credible sources such as reputable news outlets, but also from unverified sources that might breed misleading content (Figenschou and Ihlebæk, 2019). Given that alternative news sources have gained in popularity, few studies have attempted to understand how use of these sources affects and manifests into individuals' information acquisition, let alone the consequences of consuming or mixing such sources with traditional sources. This study aims to close this gap and provides further knowledge regarding the use of sources varying in terms of authoritativeness in crisis information acquisition, where individuals may rely on unverified and even misleading information. The study also aims to understand whether use of such sources affects key outcome variables, such as risk perceptions, by considering these alternative sources when mapping individuals' convergence patterns.

Medium. Information from various sources comes to life through different mediums, creating individuals' convergence experience related to media exposure. The first theoretical framework that touches on medium convergence is the channel repertoire approach to understanding information dissemination and exposure. Channel repertoire as a concept was first proposed in the 1980s regarding TV viewers' channel choices. Heeter (1985) argued that TV viewers only select a repertoire of a few channels to regularly watch over time. With the growing number of media options, a channel repertoire approach to audiences' information exposure becomes increasingly relevant and popular. This approach not only better represents the reality of a complex information environment that the audience find themselves in Sellnow et al. (2019), but also points to the importance of understanding the consequences of information dissemination and dissipation across multiple mediums.

Several key studies suggest that individuals' convergence experiences are influenced by information consumption across multiple mediums. To start, Yuan's study results (2011) confirm that people select multiple mediums when it comes to their information

needs and accessing news. More importantly, the study shows that individuals' access to news has both complementary and convergent patterns. Complementary patterns refer to individuals using different mediums for different purposes (e.g. news and entertainment) and convergent patterns for similar purposes (Chaffee, 1986). Similarly, Kim's study (2016) found that individuals use different mediums for different content options and identified five media repertoires across traditional and new media. Studies have also shown that medium usage regarding traditional and new media, however, is not always clean-cut (Neyazi et al., 2019).

Previous research has greatly expanded our understanding of medium repertoire during early use of the Internet (see Kim, 2016 for a more comprehensive overview). However, all the studies so far have focused on describing individuals' habitual use of mediums (e.g. Internet or TV) for certain gratifications (e.g. entertainment or information). This approach is more effective in establishing how and why individuals habitually use different mediums in their everyday lives but falls short in understanding one's emerging medium repertoire and its antecedents and outcomes in a high-choice and competitive information environment. Yet, in an extraordinary situation, such as an emergency that does not resemble day-to-day experiences, it is more important to understand how one's experienced situational convergence on both mediums and sources impacts their decisions.

Convergence on both source and medium. Given the proliferation of new platforms and alternative sources in today's media ecology, it is crucial to consider the intersection of sources and mediums in information acquisition. Most studies focus on either sources or mediums, thereby offering an incomplete view of information acquisition (e.g. Rains and Ruppel, 2016; Yuan, 2011). The SMCC model provides important theoretical explanations on how crisis information seeking, sharing, and verification, affects people's preventive behaviors. The SMCC model delineates three factors determining individuals' information consumption and dissemination, including channels (e.g. social media, interpersonal channels), sources (e.g. the organization responsible for handling a crisis, a third party), and types of publics (Liu et al., 2016; Zhao et al., 2018). The SMCC model alludes to the idea of convergence by recognizing the potential interactions between different sources and mediums. Yet, the SMCC model does not formally theorize the role of convergence in crisis information acquisition or explicate specific patterns of convergence.

In a crisis and risk context, scholars have found that information from multiple mediums and sources often appears to present messages that seem contradictory (Sellnow et al., 2009), including crises, such as hurricanes (Vanderford et al., 2007). Anthony et al. (2017) argued that the opposite of convergence—message divergence—can lead to disassociation with a crisis and crisis information, including natural disasters. Divergence may lead audiences to question claims, counterargue, and ultimately ignore crisis communication. Interestingly, in a natural disaster context, media convergence has led to a preference for local media, including both local television and journalism sources, which provided more consistent risk information, greater credibility, and adherence (Anthony and Sellnow, 2011).

This study theorizes convergence on both mediums and sources for more ecological understanding of individuals' convergence experience in a complex information

environment. The ongoing COVID-19 pandemic is an "infodemic" seeing a complex and dynamic information environment with an exploding volume of (mis)information. The pandemic provides a good context for this study, as it has deeply impacted people's media consumption and communication patterns. RQ1 was proposed to investigate different patterns of medium and source convergence during the pandemic.

> **RQ1:** What are the different patterns of medium and source convergence during the COVID-19 pandemic?

Factors affecting convergence patterns

In this section, we discuss the roles of demographic differences, personal motivations, affordances, and source trust in driving different convergence patterns.

Demographic factors. Demographic variables are instrumental to understanding individuals' patterns of media use (Ruppel and Rains, 2012). A study by Ruppel and Rains (2012) exploring how individuals use complementary sources for health-related information found that age was a significant predictor. Taneja et al. (2012) showed that key demographic variables such as age, gender, and education explained media users' different patterns of media consumption.

Demographic variables, such as education and gender, have been shown to affect the number of sources and combinations of channels used in a disaster and crisis context. For example, Sommerfeldt (2015) found that, postearthquake in Haiti, variables such as education were greater predictors for information seeking and reliance than structural factors, such as living in a refugee camp after the earthquake. In addition, in this cultural context, men were more active information seekers and used more of a variety of sources than did women (Sommerfeldt, 2015). Thus, we propose the second research question:

> **RQ2:** How do demographic factors affect different patterns of convergence?

Personal motivations. In addition to demographic variables, personal motivations can also affect individuals' experiences of convergence that involves the merging flow of information from various sources on different mediums in a combination of modalities. This notion is hinted at by message convergence theory (Anthony and Sellnow, 2016). According to the theory, when it comes to competing narratives, message convergence is "a potentially persuasive condition arising from the interaction of arguments" (Anthony et al., 2013: p. 350) based on people's evaluation of competing arguments from different sources in addition to a person's reflection of how information fits into his or her personal circumstances and contexts (i.e. social cognitive theory, Bandura, 2001). Consequently, when people make sense of the myriad information, their own motivations for evaluating such information come into play.

The first layer of personal motivations is related to individuals' orientation toward the problem. Issue involvement, the extent to which an issue is personally important and salient, may increase cognitive elaboration, and those who are more involved may have

a higher motivation for information processing (Petty and Cacioppo, 1979). The crisis communication literature has revealed the strong predictive role of issue involvement on the amount of crisis information intake (Kievik et al., 2012) and preventive actions (Liu et al., 2019). Those who are more involved should have a higher level of informational needs and use multiple mediums and sources for reducing information insufficiency. Thus, higher issue involvement should be associated with a higher level of convergence.

H1: Higher issue involvement relates to a higher level of convergence.

The second layer of personal motivations is related to information verification. The information environment in an emergency can be populated with conflicting messages and contradictory claims. This can, in turn, drive individuals' increased tendency to verify important information (Zhao and Tsang, 2021) by identifying the points of consistency across different messages. Liu et al. (2019) also pointed out that milling (i.e. excessive information verification) exists during disasters and this tendency can potentially delay life-saving actions. Thus, those with low information verification tendency likely demonstrate a low level of convergence by consulting a limited number of sources and mediums during crises, whereas those with high information verification tendency likely exhibit a high level of convergence by examining as many sources and mediums as possible.

H2: Higher information verification tendency relates to a higher level of convergence.

Affordances. Medium affordances are instrumental to determining choices that individuals make regarding media (Fox and McEwan, 2017). What has not been well understood is how medium affordances can affect patterns of media use. The current repertoire approaches have not been fully understood in the new multifaceted information environment, where individuals prefer certain mediums because of their unique features. Affordance theory suggests that each medium has a set of affordances or interface features that define the possibilities of content and user experiences (Sundar and Limperos, 2013). For example, social media in general, compared with traditional media, may afford more interactivity, visibility, or persistence. Affordances have been conceptualized similarly to features or attributes of communication channels (Fox and McEwan, 2017), defined as the functional attributes of the channel (Gibson, 1979), although other scholars have suggested that affordances should be assessed as perceived by the user (Norman, 1990). Therefore, medium convergence creates an experience of risks and emergencies that goes beyond the sum of the individual parts, that is an aggregated and multilayered experience based on individual predispositions, chosen sources, and platform affordances.

RQ3: How do medium affordances relate to different patterns of convergence?

Source trust. Trust in sources varying in authoritativeness can also affect individuals' patterns of convergence. Trust in communication is defined as "the generalized expectancy that a message received is true and reliable and that the communicator demonstrates competence and honesty by conveying accurate, objective, and complete information" (Renn and Levine, 1991: p. 179). A myriad of studies indicates that trust is a significant factor when individuals decide where to look for information, particularly when it is related to health and risks (Allen and Young, 2012).

A survey done by Mourão et al. (2018) indicates a clear divide when it comes to media trust based on political ideology, and a sizable portion of participants show low trust in mainstream media. The difference between trust in alternative versus mainstream sources can be confounded and influenced by individuals' trust and confidence in governance (Brewer and Ley, 2013). In this sense, alternative sources may complement one's perceived shortcomings of authoritative and official sources that are slow to respond, impersonal, and emotionally unsatisfying (Lee and Hawkins, 2010). Given these underlying differences, we position that trust in official sources versus alternative sources makes a difference in the level of convergence in a high-risk situation. Those with lower trust in official sources and higher trust in alternative sources should have high convergence by seeking crisis information from alternative sources.

> **H3**: Lower trust in official sources (a) and higher trust in alternative sources (b) relate to a higher level of convergence.

Convergence outcomes

As mentioned earlier in the literature review, the convergence framework posits that convergence exposure, affected by demographic factors, personal motivations, medium affordances, and source trust, creates lived convergence experiences. These experiences, in turn, lead to outcomes related to perceptions in disasters and emergencies and behaviors or behavioral intentions. Such influence has been discussed in multiple theoretical frameworks. The social amplification of risk framework (SARF; Kasperson and Kasperson, 1996) tends to focus on the roles of various institutions and risk amplification stations such as the government and the mass media enterprise in public risk perceptions. SARF provides a clear framework to examine experiences of risks in physical and sociological environments while only limitedly exploring one's social environment (Busby and Duckett, 2012). The convergence framework in this study conceptualizes how one's risk experience occurs in the emerging information environment characterized by proliferating channels and diverse sources, complementing the institutional and physical contexts noted by SARF. The focus of the convergence framework is in line with SARF in its attempts to further examine how risk perceptions are potentially altered through a person's information environment. Therefore, convergence exposure should affect perceptions of disasters, emergencies, and associated risks.

Furthermore, people who perceive higher risks are more likely to take self-protective behaviors. The risk perception attitude (RPA) framework argues that people's risk perceptions and efficacy beliefs predict their self-protective behaviors (Rimal and Real,

2003). Therefore, it can be speculated that a higher level of convergent communication across multiple mediums and sources should infer a higher level of risk perceptions and encourage individuals to take more proactive actions.

> **H4**: A higher level of convergence leads to a higher level of risk perceptions (a) and more preventive actions (b).

Method

We collected data from participants on a Qualtrics online panel from March 3 to March 15 in 2021. Using quota sampling, we obtained a panel composed of a national sample representing the US population above 18 years old in age, gender, and education. The survey contained questions on individuals' pandemic information use, perceptions, and behaviors. Qualtrics distributed the survey on behalf of the research team.

The final sample size was 620. The mean age of the sample was 47.35 ($SD = 17.46$): 18–34 (29.35%), 34–54 (35%), and 55 + (35.65%). Fifty percent were male, 49.8% were female, and 0.2% reported another gender. About 41.61% had high school or lower education levels, 46.77% had partial or full college education, and the remaining 11.61% had a graduate degree. The average household income reported by the sample was between $50,001 and $60,000. About 83.2% were Caucasians, 5.8% were African Americans, 5.3% were Asians or Pacific Islanders, 3.7% were Hispanics or Latinos, 1% were Native Americans or American Indians, and the remaining 1% reported other races.

Measurement

Pandemic information acquisition. A series of questions were adapted from the literature (Liu et al., 2016; Zhao and Tsang, 2021). The respondents indicated how often they sought COVID-19 information from various channels and sources on 7-point scales ranging from 1 "never" to 7 "always." Respondents reported their frequency of COVID-19 information seeking through different types of traditional media, mainstream and alternative news sites, mainstream and alternative social media, interpersonal sources, and governmental sources (see Table 1 for all items).

Information verification. The respondents were asked to indicate how often they engaged in the following COVID-19 information verification behaviors on 7-point scales ranging from 1 "never" to 7 "always" (Metzger et al., 2003). For example, they reported their tendency to "check to see if the COVID-19 information is complete," "seek out other sources to validate the sought COVID-19 information." The mean of information verification is 4.41 ($SD = 1.62$, Cronbach's alpha = .95).

Issue involvement. Respondents indicated the extent to which they considered the pandemic as important, relevant, and involving on 7-point scales. The mean of issue involvement is 5.58 ($SD = 1.67$, Cronbach's alpha = .94).

Table 1. Means and standard deviations of all information acquisition variables.

	Observed mean (*SD*)
Television	4.88 (2.09)
Radio	3.03 (2.12)
Newspaper	3.20 (2.24)
Books, medical journals	2.76 (2.14)
Phone calls	2.62 (2.09)
Text messages	2.67 (2.07)
Email	3.14 (2.14)
Blogs/vlogs	2.66 (2.06)
Search engine	4.06 (2.19)
Instant messaging	2.69 (2.18)
Mainstream social media (e.g. Facebook, YouTube)	3.57 (2.32)
Alternative social media (e.g. Gab, Parler)	2.53 (2.11)
Mainstream news sites (e.g. cnn.com, fox.com)	3.80 (2.28)
Alternative news sites (e.g. AlterNet, Onion)	2.48 (1.98)
Family and relatives	4.01 (2.05)
Friends, colleagues, acquaintances	3.62 (2.10)
Your doctor	4.24 (2.23)
Health professionals (e.g. nurses, pharmacists)	4.42 (2.08)
Local government and health agencies	4.10 (2.06)
Federal government and health agencies (e.g. CDC)	4.20 (2.08)

Affordances. Respondents were asked to consider the channels they typically used for seeking COVID-19 information and indicate their perceived social affordances of these channels. On 7-point scales ranging from 1 "strongly disagree" to 7 "strongly agree," they reported their perceived *anonymity* ($M=4.44$, $SD=1.22$, alpha = .87), *social presence* ($M=4.38$, $SD=1.26$, alpha = .90), and *bandwidth* ($M=4.46$, $SD=1.27$, alpha = .92) of the adopted channels (Fox and McEwan, 2017). Examples of statements include: "I prefer channels that can make me anonymous to the person I am communicating with," "The channels I used make it feel like the other person is present," and "The channels allow me to convey emotion."

Trust in official versus alternative sources. On 7-point scales ranging from 1 "not at all" to 7 "extremely," respondents indicated their trust in official sources, including trust in local government, federal government, and health professionals ($M=4.86$, $SD=1.76$, alpha = .91). Then, they indicated their trust in alternative sources, including trust in alternative news media and alternative social media ($M=2.81$, $SD=1.86$, alpha = .84).

Risk perceptions. We measured three types of risk perceptions: perceived susceptibility, perceived severity, and affective risks perception (Nan and Kim, 2014). On 7-point Likert-type scales, perceived susceptibility was measured by three items: "It is likely that I would be infected with COVID-19 in the next few months," "I am at risk for

being infected with COVID-19," and "It is possible that I get COVID-19 compare with others of your age and sex" ($M=3.44$, $SD=1.44$, alpha$=.90$) On a 7-point scale ranging from 1 "not at all" to 7 "very much," the respondents reported their perceived severity by indicating the extent to which they believed that getting COVID-19 would affect their life, COVID-19 was harmful, and the complications of COVID-19 were serious ($M=5.34$, $SD=1.69$, alpha$=.91$). Affective risk perception was measured using four questions: "How worried/fearful/nervous are you about being infected with COVID-19?" ($M=4.26$, $SD=2.02$, alpha$=.97$) As the three types of risk perceptions were highly correlated, a composite measure was created by combining these items ($M=4.35$, $SD=1.46$, alpha$=.93$).

Preventive behaviors. On 7-point scales ranging from 1 "never" to 7 "always," the respondents reported how often they had been engaging in preventive behaviors, including wearing face coverings in indoor public spaces and crowded outdoor spaces, staying at least 6 feet from others, and washing hands with soap and water for at least 20 seconds ($M=4.24$, $SD=0.95$, alpha$=.83$).

Demographic variables. Age, gender, race/ethnicity, and education are demographic variables. Political orientation was also measured ($1=$very liberal, $7=$very conservative; Gadarian et al., 2020). In subsequent analysis, gender and race/ethnicity were treated as binary variables. Age and education were analyzed as continuous variables.

Analysis

To answer RQ1 on patterns of convergence, a cluster analysis was conducted through R. K-means clustering is an unsupervised machine learning technique that identifies subgroups of observations in a dataset. The rationale is to identify a clustering solution that minimizes the total within-cluster variation. Distances were measured by Euclidean distance. Following the standard procedures, first, all information acquisition variables were standardized. Then, the number of clusters was determined based on the elbow method and the gap statistics (Everitt et al., 2011). Both results supported the optimal number of 4. Last, the *k*-means clustering was conducted with four initial clusters and cluster scores were computed.

RQ2, H1, and H2 examine whether demographics, information verification tendency, and issue involvement affect convergence. RQ3 and H3 examine whether affordances and source trust affect convergence. The outcome variable of convergence has four categories based on the cluster analysis. Thus, multinomial logistic regression (MLR) was conducted to investigate the antecedents of different convergence patterns. The first group was the reference category. The significance of the overall model and that of each predictor were tested through the log likelihood ratio test (Wuensch, 2019).

H4 assumes that different patterns of convergence are associated with risk perceptions and preventive behaviors. Two multiple regressions with demographic variables as covariates were performed to test H4. Convergence was coded as three dummy predictors.

Table 2. Summary of different convergence patterns.

	Information seeking	Convergence level	Medium	Source
Deliberative Actives	Frequently	High	Wide variety of mediums, also instant messaging, phone calls	Wide variety of sources, particularly alternative sources
Digital Utilitarians	Moderate	Medium	Digital mediums	Family/friends, health professionals, government, news
Traditionalists	Moderate	Medium	Traditional media/TV	Official sources (government, health professionals)
Inactives	Rarely	Low to no	Low consumption of any medium	Low consumption of any source

Results

RQ1: convergence patterns

Answering RQ1, the results revealed four groups of information users with distinct patterns of convergence (see Table 2), ranging from high-to-low convergence and unique media consumption. Figure 1 shows the characteristics of the typical case for each cluster. The group with the highest media convergence demonstrated a high level of convergence by proactively seeking a large amount of COVID information from a diversity of sources and channels. This group consulted with mainstream sources to a moderate extent but frequently engaged with alternative sources, such as alternative social media or news sites, likely to validate the veracity of their sought information. Meanwhile, this group valued the channels that allowed multimodal content and timely information exchanges, like instant messaging or phone calls. Overall, they exhibited a proactive and reflective style of information acquisition. This group is termed deliberative actives (18.3%) (see Table 2).

The group next highest in convergence demonstrated a moderate level of source and medium convergence. They did not seek much COVID information. When a need for pandemic information arose, they adopted a utility-oriented approach to information management using different sources for COVID information, including family and friends, health professionals, government agencies, and news media. They also relied on both mainstream and alternative media for pandemic information consumption. This group, termed digital utilitarians (23.4%) mostly engaged with digital channels, like instant messaging, email, and social media, as these platforms allow them to access content conveniently from different sources.

Displaying a relatively low level of convergence, the next group primarily sought COVID information from official sources (government agencies and health professionals) through television. They preferred traditional channels that allowed abundant audiovisual cues, like watching television and chatting with doctors, nurses, or pharmacists. They only consumed a small volume of COVID information from their
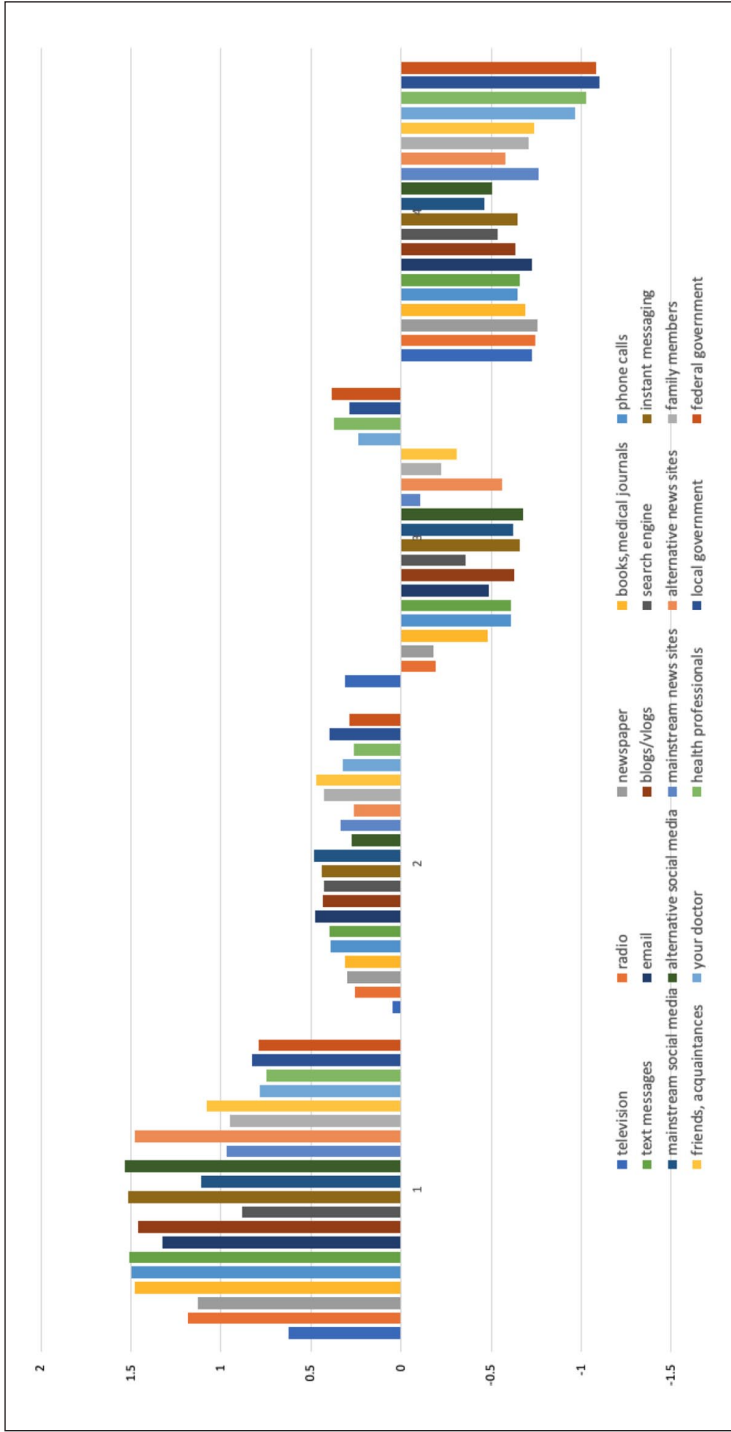
Figure 1. The means of information seeking variables in final clusters.
Note. Group 1 = Deliberative Actives (DAs), Group 2 = Digital Utilitarians (DUs), Group 3 = Traditionalists, Group 4 = Inactives.

Table 3. Parameter estimates of significant correlates of convergence.

Individual correlate	Traditionalists (TR) vs	B (SE)	Odds ratio	p
Age	Digital Utilitarians (DU)	−0.03 (.01)	0.97	<.001***
	Deliberative Actives (DA)	−0.04 (.02)	0.96	.02*
	Inactives (IN)	−0.02 (.01)	0.98	.08
Gender	DU	−1.08 (.32)	0.34	<.001***
(reference group: female)	DA	−0.18 (.51)	0.83	.72
	IN	−0.54 (.30)	0.58	.07
Education	DU	0.42 (.11)	1.52	<.001***
	DA	0.60 (.17)	1.82	<.001***
	IN	0.04 (.12)	1.05	.71
Issue involvement	DU	0.06 (.12)	1.07	.60
	DA	0.27 (.19)	1.32	.15
	IN	−0.33 (.11)	0.72	<.001**
Information verification	DU	0.24 (.10)	1.26	.02*
	DA	0.56 (.21)	1.76	.01**
	IN	−0.21 (.10)	0.81	.03*
Anonymity of the channels	DU	−0.11 (.13)	0.90	.43
	DA	0.16 (.20)	1.18	.41
	IN	0.41 (.14)	1.51	<.001**
Trust in official sources	DU	−0.27 (.11)	0.77	.01**
	DA	−0.21 (.90)	0.81	.27
	IN	−0.64 (.10)	0.53	<.001***
Trust in alternative sources	DU	0.54 (.10)	1.72	<.001***
	DA	1.47 (.17)	4.36	<.001***
	IN	−0.03 (.12)	0.97	.80

Note. Only the significant results were shown for simplicity. The reference group was traditionalists.

preferred sources and channels, thereby demonstrating a relatively passive yet selective style of pandemic information management. This group is labeled as traditionalists (28.6%) (see Table 2).

Finally, the group displaying the least information seeking and convergence is termed as inactives (29.7%) (see Table 2). Inactives sought little information and experienced little convergence. They exhibited an extremely low tendency to seek COVID-19 information from official sources such as government agencies.

In sum, we identified four patterns of convergence: traditionalists, digital utilitarians (DU), deliberative actives (DA), and inactives. DA had the highest level of convergence, as they sought COVID information frequently and extensively by consulting both alternative and official sources through different channels. DU demonstrated a moderate level of convergence, as they sought a moderate amount of COVID information from diverse sources through digital channels. Traditionalists showed a low level of convergence due to their reliance on traditional channels and sources. Last, inactives exhibited no convergence.

Antecedents of convergence

Based on the results, the inclusion of demographic factors, personal motivations, affordances, and source trust significantly improved the model-data fit as compared with a null model with no predictors, $\chi^2(36, N=620)=717.60$, Nagelkerke $R^2=.73$, $p<.001$. Table 3 displays the estimated parameters, with traditionalists as the reference group.

Regarding the demographic correlates of convergence (RQ2), our results showed that age, gender, and education were significant predictors of convergence. As compared with DU and DA, those with relatively high levels of convergence, traditionalists, those with relatively low levels of convergence, were more likely to be older and of a lower education level. As compared with DU, traditionalists were also more likely to be male rather than female. Inactives and traditionalists did not differ in terms of demographic variables.

H1 and H2 hypothesized that issue involvement and information verification tendency would correlate with convergence, respectively. Our results showed that information verification was significantly correlated with convergence level, supporting H2. As compared with traditionalists, DA ($OR=1.76$, $p<.01$) and DU ($OR=1.26$, $p<.05$) were both more likely to perform information verification, and inactives ($OR=0.81$, $p<.05$) were less likely to verify the information. However, traditionalists, DAs, and DUs did not differ in issue involvement. Only inactives felt less involved with the issue as compared with traditionalists, thus H1 was not supported.

RQ3 asked whether affordances would correlate with convergence. For affordances (RQ3), we found that only inactives placed higher importance on perceived anonymity of the communication channels ($OR=1.51$, $p<.001$) as compared with other groups. H3 hypothesized that source trust would correlate with convergence. For trust in official sources (H3a) and trust in alternative sources (H3b), we found that DU, those with a moderate level of convergence, had lower trust in official sources ($OR=0.77$, $p<.01$) as compared with traditionalists, those with a low level of convergence. However, DA, those with a high level of convergence, reported a high level of trust in official sources like traditionalists did. In other words, lower trust in official sources was not directly associated with higher convergence. Thus, H3a was not supported. However, we found that those with a relatively high level of convergence, including DA ($OR=4.36$, $p<.001$) and DU ($OR=1.72$, $p<.001$), reported much higher trust in alternative sources than traditionalists did. As such, H3b was supported.

Outcomes of convergence

H4 hypothesized that different patterns of convergence would be associated with risk perceptions (a) and preventive behaviors (b). Results showed that being a DA ($B=1.75$, $SE=0.17$, $p<.001$), a DU ($B=1.17$, $SE=0.15$, $p<.001$), or a traditionalist ($B=1.12$, $SE=0.14$, $p<.001$) was positively associated with risk perceptions, as compared with being an inactive. Similarly, being a DA ($B=0.54$, $SE=0.12$, $p<.001$), a DU ($B=0.04$, $SE=0.01$, $p<.001$), or traditionalist ($B=0.58$, $SE=0.10$, $p<.001$) was also positively associated with preventive behaviors, as compared with being an inactive. Both H4a and

Table 4. Means of risk perceptions and preventive actions across different convergence groups.

Groups	Perceived risks	Preventive actions
Deliberative actives (DA)	5.11	4.29
Digital utilitarians (DU)	4.55	4.29
Traditionalists	4.67	4.52
Inactives	3.42	3.89

Note. Perceived risks and preventive actions were measured on 7-point scales. For perceived risks, all pairwise comparisons were significant, expect for the DU-traditionalists pair. For perceived actions, three pairwise comparisons were significant, including inactives-traditionalists, inactives-DA, and inactives-DU.

H4b were supported. Table 4 reports the mean scores across different convergence groups. Additional analysis of variance and post hoc tests also supported the results of regressions (see the notes of Table 4 for details).

Discussion

This study profiled four kinds of information users with distinct patterns of medium and source convergence during the COVID-19 pandemic. We also investigated how these convergence patterns were affected by various antecedents and led to distinct outcomes. Our results suggest that demographics, information verification tendency, particular media affordances (i.e. perceived anonymity of channels), and trust in alternative sources affect the patterns of convergence. The experienced level of convergence is positively associated with risk perception but not necessarily preventive actions. The results are detailed as follows.

Researchers have begun to examine archetypes for media convergence behaviors in social media crises (Mirbabaie et al., 2021), identifying the importance of these behavior patterns. Our analyses first revealed the unique characteristics of those with different convergence patterns. First, traditionalists were more likely to be older, male, and of a lower education level. They selectively acquired information from the official sources that they trusted through television. Second, DU tended to be younger, female, and of a relatively higher education level. They placed higher trust in alternative sources rather than official sources, and they valued digital media that allowed them to access diverse content. Third, DA turned out to be the group with the highest level of education and the strongest tendency of information verification. They sought information from both official and alternative sources through various digital and traditional media. Last, inactives, as defined by their inactivity on multiple platforms and in using multiple sources, were likely to be less educated and felt much less involved in the pandemic. They distrusted official sources and valued the anonymity of communication channels. As a result, they showed nearly no convergence.

We found that different convergence patterns were driven by information verification tendency, medium affordances, and trust in alternative sources. Namely, a higher information verification tendency was associated with a higher level of convergence. Trust in alternative sources also led to a higher level of convergence. In comparison, issue

involvement and trust in official sources were not associated with a higher level of convergence. The results suggest that convergence levels were primarily driven by individuals' attempts to verify the myriad information from multiple sources and channels, notably from alternative, unofficial sources that likely provide unfiltered and niche information. Past research suggests that issue involvement can lead to higher information consumption (Kievik et al., 2012; Kim and Grunig, 2011). However, our results suggest that convergence patterns were not affected by issue involvement in general, as only inactives felt less involved with the pandemic. Convergence patterns likely manifest from individuals' thoughtful seeking and systematic processing of relevant information. Future research could investigate how those with different convergence styles process a combination of messages.

Unexpectedly, certain medium affordances turned out to inhibit convergence, as inactives who valued the anonymity of channels acquired little crisis information and experienced very low convergence. Among the three general medium affordances tested in this study, social presence and bandwidth did not affect convergence patterns, suggesting that convergence patterns were not primarily driven by strong social presence or how rich the channel is. On one hand, the results provide further evidence that convergence patterns in a complex information environment consisting of multimedium, multisource, and multimodality were not determined only by medium characteristics. We do note that we tested only three medium affordances from a list of affordances identified by Fox and McEwan (2017). Future research is recommended to dive deeper into how additional medium affordances affect convergence patterns.

Furthermore, the analyses on the outcomes of convergence partially supported that higher convergence was associated with higher risk perceptions and preventive actions. More specifically, higher convergence translated into higher levels of risk perception. DA had the highest level of convergence across mediums and sources, followed by DU and traditionalists, and inactives. And their risk perceptions approximately matched their levels of convergence. Such results indicate that convergence increases situational awareness of risks during crises.

However, our results also indicate that the level of convergence did not match perfectly with the intentions to take preventive action. Though deliberative actives had the highest levels of risk perceptions, they were not more likely to take preventive action compared with traditionalists. This reflects a complicated relationship between risk perception and individuals' protective action taking. Past research suggests that a higher level of information seeking may indicate milling (Liu et al., 2019), a phenomenon where individuals seek excessive information and overly verify information while delaying life-saving measures in disasters. Similarly, the results from the current study suggest a possible nonlinear relationship between information acquisition and preventive action taking, where convergence translates to higher preventive action to a certain degree. Information "over-seeking" may increase the likelihood of individuals to receive more inconsistent messages. It can also be a sign of information overload that contributes to information fatigue or a sign of individuals milling. The potential nonlinear relationship between information seeking and preventive action-taking has significant implications on risk and disaster communication and warrants more future research.

Theoretical implications

Existing theories such as the repertoire approach have contributed to our understanding of the role of medium and source multiplicity in media consumption in traditional media environment. However, conventional patterns of information acquisition revealed by these frameworks (e.g. people use different channels in a complementary manner for different purposes) do not adequately describe today's complex and dynamic information ecology. These approaches also fall short in incorporating individuals' information consumption patterns and processing strategies in the high-choice media environment populated with alternative sources and problematic content. To fill these gaps, the convergence framework was created to systematically theorize the simultaneous use of information from a plethora of sources and channels, along with its antecedents and outcomes, during emergencies and disasters when information needs heighten. The convergence framework hopefully provides a more ecological and comprehensive description of diverse information acquisition patterns in the multimedium, multisource, and multimodal information environment. However, it is important to recognize that convergence occurs at different levels, including but not limited to mediums and sources. Future research, if possible, should investigate the patterns of convergence using more variables such as modality or information veracity. For example, when an individual experiences convergence on modality, the person can sense information across various modalities, such as text, visual, and audio. With different senses engaged, the person can effectively interpret a message without overtaxing only one sense. Future research can examine how multimodal content facilitates crisis sensemaking.

   The message convergence framework points out the importance of considering the degree of source convergence in crisis information consumption. A repertoire approach highlights the complementary use of traditional channels for fulfilling one's gratifications. Going beyond the two perspectives, the convergence framework emphasizes convergence on emerging and traditional mediums as well as official and alternative sources, all of which condition a unique information environment where individuals typically encounter and process diverse, conflicting, or even contradictory perspectives. Our findings add to the traditional information seeking and media consumption literature by highlighting the roles of information verification tendency, trust in alternative sources, and perceived medium affordances in crisis information acquisition and convergence. Additional antecedents, such as one's personality traits, emotional status, or cognitive style (e.g. need for closure, attitude ambivalence), probably contribute to different patterns of convergence. By exploring different kinds of antecedents of convergence, traditional theories, such as the SMCC model, can be enriched by the convergence framework.

   Furthermore, how different patterns of convergence manifest into protective actions are still unknown. Individuals' information processing mechanisms, such as cognitive elaboration or information overload, may intervene in the relationship between convergence patterns and behavioral outcomes. For COVID-19 vaccines, the perceived inconsistency between different pieces of information online could strengthen the amount of information overload experienced, increase vaccine hesitancy, and lower

vaccination behavioral intentions. This is an open research area that will benefit from more theorization and empirical efforts. More studies are needed to help develop a valid understanding of the perceptual processes and behavioral outcomes of those with different patterns of convergence.

In addition, research in crisis communication suggests the importance of health and media literacy in times of crisis, defined as individuals' capacity to obtain and process news information (Roberts and Veil, 2016). Individuals who engage in over-seeking of news information may have a hard time distinguishing between seeking quality information and processing this news information. Taking into account health and media literacy levels in crisis communication message planning can help to provide clearer crisis communication (Roberts and Veil, 2016).

Limitations and future directions

First, although most of our hypotheses based on the convergence framework were supported, theoretical boundaries and generalizability of the convergence framework are still unknown, as this study was the first to empirically test the convergence framework. Given the significance and implications of convergence in today's dynamic information ecology, we call for more research testing, updating, and extending the convergence framework in other contexts, such as natural disasters, food recalls, or doctor–patient interactions.

Next, the survey design prevents us from inferring any causal relationships. For instance, higher convergence can cause higher perceived risks due to the social amplification of risks through various communication channels. Meanwhile, people's perceived risks could heighten their convergence driven by their higher level of informational needs. A cross-sectional survey does not allow us to test the potentially reciprocal relationship between convergence and risk perceptions. Future research should use experiments to investigate the causal relationships.

An additional limitation of this study is that participants were all located within the United States. Future research is recommended with a global population or participants located in different countries, to examine potential differences due to culture and differing media environments.

As mentioned earlier, media and health literacy present an interesting opportunity for study, as individuals' literacy levels may impact their information seeking and convergence patterns. We recommend that future research consider media and health literacy as a variable for study in examining convergence patterns. This study is also limited to views on trust and sources of information after the pandemic began. Additional research might consider trust and views on sources pre- and postpandemic to examine trends and differences, given the erosion in trust in the U.S. media environment and competing messaging.

Finally, qualitative research, such as in-depth interviews, is recommended to further examine content and message convergence, in addition to source/medium convergence. Follow-up interviews with participants could help to examine how much content convergences and how this content convergence relates to source and medium convergence.

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