

## **Partisan News Repertoire and Echo Chamber in High-Choice Media Environment**

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## **Partisan News Repertoire and Echo Chamber in High-Choice Media Environment**

### **Abstract**

Although echo chamber phenomenon has attracted considerable attention, the measurement of echo chambers has been inconsistent and insufficient. Using a nationally representative panel survey from Taiwan (N = 1,926), the current study introduced the Partisan News Repertoire Index to explore the presence of echo chambers in high-choice media environment, and found support for polarization in echo chambers by integrating news repertoire approach and biased assimilation theory. Results showed that two of five news repertoires were mainly driven by political ideology, indicating stronger partisan news repertoire. Moreover, people with strong partisan news repertoires tended to be polarized by self-confirming process when encountering consistent partisan media; and also strengthen their prior attitudes through motivated reasoning when exposed to inconsistent partisan media.

*Keywords:* Echo chamber, Partisan News Repertoire Index, high-choice media environment, biased assimilation, polarization

### Partisan News Repertoire and Echo Chamber in High-Choice Media Environment

With the developments and prevalence of Internet and social media, a large and growing body of literature has warned that people would live in echo chambers due to selective exposure and algorithm (Bakshy, Messing, & Adamic, 2015; Cardenal, Aguilar-Paredes, Cristancho, & Majó-Vázquez, 2019). Researchers argued that Internet and social media reinforce selective exposure, people are more likely to connect with like-minded others, be exposed to attitude-aligned information, and form homogenous communities than ever, and thus result in fragmentation, polarization, and diffusion of misinformation (DeVicario et al., 2016; Jacobson, Myung, & Johnson, 2016; Williams, McMurray, Kurz, & Lambert, 2015). However, the current study argued that echo chamber is not a new phenomenon which only existed on Internet or social media because individuals are embedded in a high-choice media environment, including multiple media platforms and diverse media contents. As Dubois & Blank (2018) noted that “it is important to consider how they interact with their entire media environment” (Dubois & Blank, 2018, p.730), therefore, we tried to adopt a news repertoire approach to examine whether individuals live in an echo chamber, and how their media environment influences attitudes.

The concept “echo chamber” describes that people are captured in a segmented and bounded chamber with like-minded opinions echoing with one another, and hence a single viewpoint has dominated and was intensified, at the same time, competing views are limited and censored (Bastos, Mercea, & Baronchelli, 2018; Karlsen, Steen-Johnsen, Wollebæk, & Enjolras, 2017; Shmargad & Klar, 2019). However, the measurement of echo chambers was inconsistent and insufficient, and most of studies emphasized on social media neglecting other media and offline media (Dubois & Blank, 2018). Therefore, the current study tried to fill the gap to develop

an index to measure the presence of echo chambers, and provided a novel way to test the antecedent and consequence of echo chambers.

To shed more light on the echo chamber phenomenon, the current study used a nationally representative panel survey from Taiwan (N = 1,926) to examine how different types of news repertoire emerge and what the degree of partisan news repertoire reflecting the group of people inside echo chambers. Furthermore, we integrated Partisan News Repertoire Index and biased assimilation theory to examine the common echo chamber effect—polarization, to reveal the underlying psychological mechanisms in echo chambers.

## **Literature Review**

### **Echo Chamber: A News Repertoire Approach**

Prior studies had used different measurements to examine echo chambers, however, resulted in conflicting evidence. Some emphasized how the affordance of Internet and social media enables users to be exposed to like-minded opinions through a big data approach (Colleoni, Rozza, & Arvidsson, 2014; DelVicario et al., 2016; Matuszewski & Szabó, 2019; Williams et al., 2015). For instance, to identify whether Twitter is an echo chamber or public sphere, Williams et al. (2015) examined how people follow, retweet, and mention related to climate change on Twitter. They found people were more likely to be inside echo chambers in follow and retweet network which both networks showed high-level homophily between like-minded users and high-level segregation between attitudinal-discrepancy users; however, low-level homophily in mention network. At the same time, some researchers conducted surveys to ask people what the degree they interact with like-minded people and expose to ideologically similar information (Dubois & Blank, 2018; Wollebæk, Karlsen, Steen-Johnsen, & Enjolras, 2019) or what media they often consume for news (Fletcher & Nielsen, 2017; Webster & Ksiazek, 2012). For instance,

Dubois & Blank (2018) measured echo chamber by five variables, including active exposure to consistent information and active avoidance to inconsistent information. Based on their findings, they argued the echo chamber is overstated. Taken together, conflicting results may be due to inconsistent and insufficient measurements. As Dubois & Blank (2018) criticized, social media studies focus on a single platform and ignore the high-choice media environment. Similarly, the survey emphasized on self-reported selective exposure behaviors, which may confound two concepts—selective exposure and echo chamber. We argued that selective exposure focuses on individual level whereas echo chamber emphasizes on group level; and the deep concern of echo chambers is that ideological fragmentation among groups may tear people apart in society. Therefore, the current study tried to adopt a news repertoire approach to examine how different news repertoires may capture particular groups of people into echo chambers in multiple media environment.

The concept of repertoire was first introduced by Heeter (1985), who used channel repertoires to describe how people develop a routine way to watch the particular set of channels on television when facing a number of channel options. With the growing of a high-choice media landscape, numerous studies have extended the concept of repertoire in many circumstances. News repertoire can be referred to the set of news outlets that an individual seeks for news in a habitual way (Edgerly, 2015). News repertoire perspective enables researchers to identify the distinct and patterned way how users consume news from a variety of media platforms and contents (Edgerly, 2015), and reflects the growing and high-choice media environment (Wolf & Schnauber, 2015). For instance, Edgerly (2015) revealed six types of news repertoires by analyzing national survey data of news usage across newspaper, television, and online news websites. Although some people were identified as news avoiders, news omnivores and medium-

centric news seekers, two clusters with highly ideological news consumption emerged in the colorful news landscapes. Their findings showed that about 12.2% respondents preferred to seek out news with liberal stances, and 15.6% respondents were inclined to use conservative news media. It indicated that only these people with highly ideological-oriented news consumption were more likely to live in echo chambers.

The current study argued that the news repertoire approach enables researcher to shed the light on the phenomenon of echo chambers and conflicting results. First, unlike prior studies debated whether echo chambers exist or not, we articulated that echo chamber phenomenon has attracted considerable attention because of negative consequences rather than the presence itself. Many news repertoire studies found some groups of people had biased news diets based on their congruent ideology rather than all population (Edgerly, 2015; Ksiazek, Kim, & Malthouse, 2019), and those may be segregated or polarized due to being in echo-chamber like environment. Second, previous studies were inclined to show the phenomenon of echo chambers, such as the co-occurrence of homophily, segregation, negativity toward outgroups and polarization (DeVicario et al., 2016; Williams et al., 2015); however, rarely examined the causes and effects of echo chambers. News repertoire approach provided the detailed combination of news consumption of particular groups, and to further examine how different news repertoires influence different groups' political engagements and participations (Edgerly, 2015; Ksiazek et al., 2019; Wolfsfeld, Yarchi, & Samuel-Azran, 2016). Therefore, we argued that the news repertoire approach enables researcher to examine the antecedent and consequence of echo chamber of living in echo chambers.

### **Defining Partisan News Repertoire Index**

The current study tried to examine echo chamber phenomenon by developing and testing a measurement—Partisan News Repertoire Index. Unlike the previous studies used several variables and relied on selective exposure items to represent the presence of echo chamber, we tried to develop an index to measure the degree of echo chamber grounded on the concepts of partisan selective exposure and news repertoire.

Partisan News Repertoire Index be referred to *the degree of the particular set of one-sided partisan media outlets across multiple medium which a group of individuals regularly use to get news in a high-choice media environment*. Instead of focusing on individual's preference, we used partisan news repertoire to emphasize a particular group of people exposed to homogenous partisan media and received one-sided and like-minded opinions continuously. We argued that this term captures the similar idea to echo chamber that how a group of people lived in echo chambers and how different groups were segregated.

There are four characteristics of Partisan News Repertoire Index to reflect the antecedent of echo chamber, including partisan selective exposure, repeated and cross-media exposure, preferential algorithm of news aggregators and social media, and low viewpoint diversity.

#### ***Partisan Selective Exposure***

Building on echo chamber literature, it suggests that partisan selective exposure and algorithm are the main causes of echo chambers (Bakshy et al., 2015; Cardenal et al., 2019; Dubois & Blank, 2018). Partisan selective exposure can be defined as the preference which people are more likely to select media outlets sharing their political ideology based on the theory of selective exposure (Stroud, 2010). Although there are diverse media outlets and multiple media platforms, ideologically driven news has been the main trend of high-choice media

environment and viewed as an efficient way to attract audience (Edgerly, 2015). Ideologically driven news prefers to provide limited and bias public agendas and many news outlets have divided into two clusters of homogenous political orientations in a country, such as blue media and red media in the United States (Edgerly, 2015; Iyengar & Hahn, 2009). Furthermore, many studies showed that echo chambers were driven by strong partisanship, and referred to partisan echo chambers (Dubois & Blank, 2018; Shmargad & Klar, 2019). Therefore, Partisan News Repertoire Index focused on how ideologically like-minded and dissimilar partisan media were included in each news repertoire.

### *Repeated and Cross-Media Exposure*

As prior research had employed news repertoire to measure the size and media combination of news use (Edgerly, 2015; Edgerly, Vraga, Bode, Thorson, & Thorson, 2018; Yuan, 2011), Partisan News Repertoire Index also concern the total size of partisan media exposure. Increased and exclusive exposure to cross-media news outlets shaped individual's world view and resulted in a fragmented public agenda (Chan & Lee, 2014). For instance, Muddiman, Stroud, & McCombs (2014) found peoples' opinions about "withdraw from Iraq" were influenced by the total exposure to Fox News and CNN, which Fox News viewers support the Iraq War whereas CNN viewers believed the United State should withdraw troops. Furthermore, they found people watching both CNN and MSNBC were more likely to say the United State should withdraw troops and the Iraq War was not worth it than viewing CNN alone or viewing both CNN and Fox News. Similarly, a particular viewpoint would be enforced and rebuttals would be insulted due to the parallel of like-minded voices echoing with one another in an echo chamber. Therefore, Partisan News Repertoire Index focused on the total repeated and

cross-media exposure to partisan media; and argued that the more homogenous partisan media exposure, the more likely to being in echo chambers.

### *Algorithm-Based Media of News Aggregators and Social Media*

Recent studies investigated how affordance of Internet and social media capture individuals into echo chambers based on the filter bubble argument (Pariser, 2011). As mentioned before, partisan selective exposure and algorithm are the main causes of echo chambers (Bakshy et al., 2015; Cardenal et al., 2019; Dubois & Blank, 2018); however, rather than active selection by individuals, algorithm is an invisible and complex mechanism to determine the information flow and presentation by technological corporations (Thorson & Wells, 2016). Although algorithm may be determined by many factors, such as interaction with friends, commercial or political power, and personal preference, the basic logic of algorithm is personalization. Personalization reflected personal preference by tracing digital footprints and active customization (Karimi, Jannach, & Jugovac, 2018; Thurman & Schifferes, 2012). For instance, by analyzing big data containing 10.1 million active Facebook users' sharing links, Bakshy et al. (2015) found low opportunities (approximately 5%-8%) for Republicans and Democrats to see ideologically inconsistent information compared to consistent ones after algorithmic rankings, and the rate to select inconsistent information compared to consistent ones was 6%-17%, and hence further strengthened the creation of echo chambers. Therefore, since online news aggregators (e.g., Google News and Yahoo) and social media (e.g., Facebook) have become main news sources (Antunovic, Parsons, & Cooke, 2016), we argued that Partisan News Repertoire Index would distinguish algorithm-based media from partisan media because these media would strengthen the effects of personalization and reflect personal preference.

### *Low Viewpoint Diversity*

Viewpoint diversity can be referred to diversity of frames or agendas on a given topic, and often used to measure the degree of news diversity in a marketplace of ideas (Haim, Graefe, & Brosius, 2017). In line of echo chambers, many empirical studies have found that people are likely to interact with like-minded others to form homogenous groups, and a single view often dominated the opinion climates by the process of like-minded voices confirming with another in the groups. For instance, Jacobson, Myung, & Johnson (2016) studied how users used links to express their opinions in discussion forum on two partisan Facebook Pages, because they argued that the usage of links imply the extent users lived in an open media or echo chamber. They found about half of the sources were referenced by only one-sided audience rather than both sides, and each Page received a large amount of partisan-consistent information from small and limited sources. That is, these fan pages created information enclaves where people were exposed to like-minded and limited information congruent with their political orientations. Similarly, Williams et al. (2015) examined how users used hashtags to express their opinions about climate change, and found two segregated and homogenous communities between supporters and opponents. In each community, they found an apparently single viewpoint dominated and rare opposing viewpoints. Furthermore, Karlsen et al. (2017) further argued that an echo chamber may create a spiral of silence where minority may perceive the dominant viewpoint, and hence keep silence due to the fear of social isolation. Therefore, Partisan News Repertoire Index concerns viewpoint diversity in each news repertoire. That is, the lower viewpoint diversity exhibit in news repertoires, the more likely to be in echo chambers.

## **Antecedent and Consequence of echo chamber**

### ***Blue Media and Green Media in Taiwanese Context***

Here, we tested antecedent and consequence of echo chambers in the context of Taiwan. Although the concern of echo chambers has attracted a great deal of scholarly attention; however, most of the literature has focus on the Western context (Matuszewski & Szabó, 2019), especially in the United States (Colleoni et al., 2014; Flaxman et al., 2016; Jacobson et al., 2016). The current study aimed to investigate the echo chamber phenomenon in Taiwan, a non-Western country which national politics have been dominated by the pan-blue camp (led by the Kuomintang, KMT) and the pan-green camp (led by the Democratic Progressive Party, DPP) since 1987. Like the division between red media and blue media in the United States, the similar pattern also happens in Taiwan where dominated by blue media and green media (Wu & Guo, 2017). In order to test how partisan news repertoire capture individuals into echo chambers and the consequence, we proposed research questions to identify the types of news repertoires in Taiwan and those reflect what the degree of partisan news repertoire.

**RQ:** How do different types of news repertoires reflect the degree of partisan news repertoire in high-choice media environment?

### ***Biased Assimilation in Echo Chamber***

Prior studies often found co-occurrences of political homophily, partisan selective exposure, segregation and polarization in echo chambers, however, researchers seldom tested the causal relationships due to the lack of appropriate measurements. For instance, Williams et al. (2015) found people were more likely to connect with like-minded people to form a homogenous community, and a single viewpoint dominated the opinion climate. At the same time, they found people were polarized in highly homogenous community where they had positive emotion

toward in-group information and exhibited negativity toward outgroups and inconsistent information. Likewise, in the study of DeVicario et al. (2016), they investigated how Facebook users consume scientific and conspiracy news and found these two distinct narratives divided into two homogenous clusters based on news diffusion. They found homogeneity and polarization were two main characteristics in these two cluster. Both studies used big data to examined the phenomenon of echo chambers; however, they did not explore the causal relationships. Therefore, the current study tried to explore the antecedent and consequence of echo chambers by developing the concept of Partisan News Repertoire Index. Although there are many negative consequences of echo chambers, we focused on polarization because the polarized groups with discrepant attitudes lead to division and fragmentation in the society and harm the function of democracy (DeVicario et al., 2016).

Many empirical research has shown that individuals' partisan selective exposure strengthens their pre-existing attitudes and further confirms their previous beliefs (Stroud, 2010), however, the current study argued that the underlying psychological mechanism in echo chambers matters. As noted by Garrett (2009), the psychological mechanism determined individuals' selection and reading behavior. The finding showed that people tended to select attitude-consistent information due to the motivation to decrease discomforts when facing attitude-challenging information; and they were likely to spend more time on attitude-inconsistent information than consistent ones due to the motivation to look for its flaws and criticize it. To extend Garrett's (2009) idea into group level, we speculate that the collective individuals with stronger partisan news repertoire will shape their social identities and tend to categorize themselves and others into groups, namely, consider like-minded ones as ingroups and the dissimilar others as outgroups. In this way, the groups of individuals may generate positive

attitudes toward ingroups and negative attitudes toward outgroups (Appiah, Knobloch-Westerwick, & Alter, 2013).

In fact, similar evidence has been found in studies of echo chambers that increased polarization when people encounter outgroups and interact with like-minded ingroups. For instance, Williams et al. (2015) found people were polarized when they had positive emotions toward ingroups and consistent information whereas negative emotions toward outgroups and inconsistent information. The results were also found in Shmargad & Klar's (2019) study, which they argued that whether people live in an partisan echo chamber determined the way how they interact with ingroups and outgroups. Therefore, tried to integrate biased assimilation theory to explain the psychological mechanism underlying echo chambers and use Partisan News Repertoire Index to test the causal relationship that how echo chambers lead to polarization.

Biased assimilation theory focus on the polarization process by the evaluation of attitude-confirming information and attitude-disconfirming information. Prior studies found people are likely to rate the consistent information more positively and convincingly, and further strengthen their prior attitudes; however, they tend to scrutinize the weakness of inconsistent information and have lower and negative evaluations, and further polarize their existing attitudes (Boysen & Vogel, 2007; Garrett, 2009; Lord, Ross, & Lepper, 1979; Munro et al., 2002; Taber & Lodge, 2006). Those studies showed polarization is mainly driven by both self-confirming and motivated reasoning process. Based on an experimental study conducted by Stroud, Muddiman, & Lee (2014), we argued that bias perception toward partisan media can be analogous to perceptions toward ingroups and outgroups in echo chamber. The findings showed that people viewed consistent partisan media as in-group members and had positive perceptions toward these media; at the same time, they held biased and negative perceptions toward dissimilar media and

saw them as outgroups. Therefore, we speculated that a group of people with high level of blue-media partisan news repertoires will be polarized when they encounter green media, and vice versa. Hence, the following hypotheses were proposed:

**H1:** Higher partisan news repertoire will increase biased assimilation toward consistent media, and greater biased assimilation toward consistent media will in turn increase individuals' polarization.

**H2:** Higher partisan news repertoire will decrease biased assimilation toward inconsistent media, and weaker biased assimilation toward inconsistent media will in turn increase individuals' polarization.

### Method

The current study used a secondary data from the 2017 Taiwan Communication Survey (TCS), an annual national survey supported by the Ministry and Science Technology in Taiwan. The 2017 TCS data were collected by face-to-face interviews from 23 August 2017 to 5 November 2017 and resulted in a representative Taiwanese sample with 18 years of age and older through multi-stage stratified random sampling ( $N = 2,138$ ). Taiwan provides an appropriate context to examine echo chamber because of a high-choice media environment and an apparently two-party system (i.e., pan-blue camp and pan-green camp) in politics. We selected sample with news exposure experiences of newspaper, television, or internet (final sample  $N = 1,926$ ). The average age of final sample was 48.80 ( $SD = 15.84$ ), and 45.5 % were male.

### Measurements

#### *Partisan News Repertoire Index*

In order to operationalize partisan news repertoire, we used several steps to construct the

index of our key variable: Partisan News Repertoire Index. The first step was to determine how many news outlets in latent class analysis. The questionnaire asked respondents to indicate which news outlets they often consume news across multiple media, including newspapers, television, and online news (Yes =1). In total, 36 questions, 144 questions, and 27 questions related to newspaper exposure, television exposure, and online news exposure separately. To achieve parsimony and avoid the inferences made about news outlets with very few users (Webster &Ksiazek, 2012; Weeks, Ksiazek, &Holbert, 2016), we followed the rule of Webster &Ksiazek (2012) which included news outlets with reach of 3% and more in our dataset. Hence, the final list consisted of 4 newspapers, 7 television news channels, and 11 online news, and our respondents were often exposed to more than one news media ( $M = 1.13$ ,  $SD = .09$ ).

Second, an expert-oriented content analysis was employed. We recruited a chief director served in a news outlet and a professor served in a communication department to evaluate the political orientation for each news outlet. Two coders relied on their expertise to indicate their perceptions of partisan media bias on a 5-point scale (from 1 = strong pro-green camp bias, to 5 = strong pro-blue camp bias) (Stroud et al., 2014). The answers were encoded into pro-green camp bias (1 and 2 recoded as 1), neutral (3 recoded as 0), and pro-blue camp bias (4 and 5 recoded as 2). The inter-coder reliability showed the evaluation was reliable: average percent agreement was 86.4%, and Krippendorff's alpha was 0.80. In terms of inconsistency, we average two coders' results to identify the political orientation. The evaluation of news outlets was shown in Appendix Section A.1.

The third step was to compute the Partisan News Repertoire Index expressed by the following equation:

$$\text{Partisan News Repertoire Index} = HHI * [B * 1 + G * (-1) + N * 0 + A * (\frac{B-G}{B+G})]$$

In the equation above, *HHI* indicates the Herfindahl-Hirschmann Index (HHI) in the news repertoire, *B* indicates the total number of blue media in the news repertoire, *G* indicates the total number of green media in the news repertoire, *N* indicates the total number of neutral media in the news repertoire, *A* indicates the total number of algorithm-based media (i.e., news aggregators and social media news) in the news repertoire.

Partisan News Repertoire Index emphasized four characteristics. First, we used the common diversity index HHI to measure viewpoint diversity (Rennhoff & Wilbur, 2014). Instead of considering media ownership, we categorized news outlets into three types based on partisan orientation (i.e., blue media, green media, and neutral media) and used it as proxies for computing viewpoint diversity. We computed HHI in R using the diverse software package. The HHI score ranges from 0 (very diverse) to 1 (very concentrated). Second, Partisan News Repertoire Index considered the influence of partisan media, so we followed the computation developed by Muddiman et al. (2014). We first added the total number of green media content analysis codes on each news repertoire, and subtracted from this the total number of blue media codes. Here, we denoted neutral media as 0. Third, in terms of repeated and cross-media exposure, we added the total number of each types of news media, and multiplied by their impact value (e.g., 1 as blue media, -1 as green media, 0 as neutral media). Fourth, to capture the influence of individual's preferential algorithm, we computed the proportion of pro-blue media orientation in each news repertoire, and then multiplied by the total number of algorithm-based media. Therefore, a higher positive score on the Partisan News Repertoire Index indicates greater blue media orientation, a higher negative score indicated greater green blue media orientation,

and 0 indicated neutral or balanced news diets.

### *Biased Assimilation*

Two objects of biased assimilation were measured, including cognitive evaluation toward blue media and green media, adapted from Lord, Ross, & Lepper (1979). Biased assimilation toward blue/green media (including newspaper, television, and online news) represents the positive evaluation toward blue/green media, which was measured by two questions (“how well or poorly the political news was on blue/green media when you are exposed to?” and “How convincing the political news was on blue/green media when you are exposed to?”) on a 4-point scale (from 1 = very poorly, to 4 = very well; and from 1 = completely unconvincing, to 4 = completely convincing). The index of blue/green media biased assimilation was created by averaging the scores (blue media:  $M = 2.33$ ,  $SD = .69$ ; green media:  $M = 2.24$ ,  $SD = .67$ ).

### *Polarization*

Polarization was measured by the difference between the feeling thermometer index of political parties of DPP and KMT on a scale ranging from 0 to 100, following Lee, Choi, Kim, & Kim (2014). The DPP thermometer scores were subtracted from the KMT scores were calculated ( $M = 2.74$ ,  $SD = 25.64$ , range = -100 to 100). The value 100 represents the polarized KMT affiliation, and value -100 represents the polarized DPP affiliation.

### *Demographic*

The control variables included three demographic variables: gender, age, and education. Education was measured by five categories (1 = illiterate, 2 = home school/elementary, 3 = junior high school, 4 = college/university, 5 = postgraduate degree;  $M = 4.06$ ,  $SD = 1.09$ ).

### **Analytical strategy**

To answer RQ, we first explored the types of news repertoires among our respondents by latent class analysis (LCA). The traditional way to identify news repertoires include two steps: researcher used principal components analysis (PCA) to group news components first, and then performed cluster analysis to identify news repertoires (Edgerly, 2015; Edgerly et al., 2018; Ksiazek et al., 2019). However, the current study argued that LCA is more appropriate because it allows researchers to identify the underlying class by analyzing multiple categorical indicators directly rather than grouping particular indicators, and these indicators are not exclusive across different classes. Furthermore, differing from traditional clustering analysis, researchers can analyze data of underlying subgroups because LCA calculated posterior probabilities for each individual (Knight & Brinton, 2017). Recent studies in communication field has used LCA to investigate latent association between observed indicators and classify the similarity and difference between the given sample, such as classifying motivation patterns and exploring social grooming styles among Facebook users (Lai, 2019; Lin, 2019). The current study conducted LCA in R using the poLCA software package. To select the perfect model, we used Bayesian information criterion (BIC) to find the best-fitting model and identify the number of latent classes by smaller BIC values (Knight & Brinton, 2017; Wang & Wang, 2012). After generating the conditional probabilities of news outlets for each news repertoire and the posterior probability of each respondent belonging to each news repertoire, we characterized the nature of each news repertoires and calculated Partisan News Repertoire Index (RQ).

To test the mediation hypothesis (H1 and H2), we employed the PROCESS macro (model 4) for SPSS developed by Hayes (2014). To test consistency and inconsistency effects between partisan news repertoire and bias assimilation on polarization, the model used Partisan

News Repertoire Index as independent variable, biased assimilation toward blue media and green media as mediators, and polarization as dependent variable.

## Results

### Partisan News Repertoire Index in Different Latent Classes

To explore the degree of Partisan News Repertoire Index in different types of news repertoires (RQ), we first used LCA to identify potential news consumption patterns. When we estimated the latent class model based on all 22 indicators (i.e., news usage across 22 news outlets), the smallest BIC value indicated that the 5-class model (BIC = 29789.23) fit the data best. The conditional probabilities in LCA enables researchers to characterize the nature of each latent class, that is, we can identify the news components in each news repertoire. According to Wang & Wang (2012), when a conditional probability (i.e., the likelihood of the observed indicator belonging to a specific class) is larger than the value of  $1/j$ , where  $j$  is the total number of latent class, the indicator can be endorsed to the underlying class. In this way, we categorized the observed indicators when the conditional probability exceeded the .20 threshold in each of the five classes in the current study. See the details in Appendix Section A.2.

Based on the results of LCA, we characterized each news repertoire by ideological orientation and calculated Partisan News Repertoire Index (see Table 1). Class 1 was labeled as *Pro-Blue* repertoire (12.7% of respondents), because respondents had higher likelihood of consuming Blue media (TVBS News) and the algorithm of aggregator (Yahoo) may show higher preference for blue media. The score of Partisan News Repertoire Index in this repertoire was 2 and the score of HHI was 1, indicating highly concentration on pro-blue partisan media and individuals were more likely to hear pro-blue camp and like-minded voices in this repertoire. The Class 2, *Nonpartisan Aggregators* repertoire (35.6% of respondents), was the biggest news

repertoire. This repertoire showed the trend that most people had no apparently ideological preferences and relied on social-oriented and algorithm-based platforms to gain news, including Social Media, Instant Messaging App, Yahoo, Google News. The score of Partisan News Repertoire Index and HHI in this repertoire was 0, indicating a nonpartisan news diet. Class 3 labeled as *Balanced Omnivores* repertoire (11.3% of respondents) preferred to consume two-sided news media (blue media: TVBS News, United Daily News Website; green media: Apple Daily Website, ETtoday) and news aggregators (Social Media, Instant Messaging App, Yahoo, Google News). Although the score of Partisan News Repertoire Index in this repertoire was also equivalent to 0, the score of HHI was .05, reflecting a balanced and diverse news consumption rather than nonpartisan preferences. Class 4 was labeled as *Pro-Green* repertoire (29.5% of respondents), because this news repertoire was structured around ideological attributes (i.e., Liberty Times and FTV were green media). This repertoire exhibited a preference for only one-sided partisan media and traditional news. The score of Partisan News Repertoire Index in this repertoire was -2 and score of HHI was 1, showing that people in this repertoires were likely to be in echo chambers because they were interested in news with pro-green camp voices. Finally, the Class 5 was labeled as *Light-Blue Omnivores* repertoire (10.9% of respondents), because individuals in this repertoire had diverse news use and consumed more blue media than green media. This omnivore news repertoire exhibited both medium-centric and attribute-centric orientation, that is, it consumed pro-blue media and pro-green media, as well as newspaper, television, and online news. The score of Partisan News Repertoire Index in this repertoire was .73 and the score of HHI was .51, showing that people in this repertoires appeared a little preference for blue camp in despite of diverse news consumption.

Taken together, approximately sixty percent of the respondents had balanced or omnivores repertoires, such as *Nonpartisan Aggregators* repertoire (35.6%), *Balanced Omnivores* repertoire (11.3%), and *Light-Blue Omnivores* repertoire (10.9%); however, 42.2% of respondents with ideological news repertoires were more likely to live in echo chambers, such as *Pro-Blue* repertoire (12.7%) and *Pro-Green* repertoire (29.5%).

### **Effects of Partisan News Repertoire on Polarization Mediating by Biased Assimilation**

H1 and H2 predicted that Partisan News Repertoire Index is related to polarization indirectly through biased assimilation toward consistent media and inconsistent media. Using the PROCESS macro (model 4) to test the mediation, we found that both indirect paths showed positive effects of Partisan News Repertoire Index on polarization (Figure 1). The indirect path estimate showed the positive, statistically significant effect of Partisan News Repertoire Index on polarization through biased assimilation toward consistent media, *point estimate* = .66, *CI* = [.134, 1.193]. That is, higher Partisan News Repertoire index will increase biased assimilation toward consistent media ( $b = .030, p < .05$ ), and in turn, this had a significantly positive effect on polarization ( $b = 21.751, p < .001$ ). These findings support H1. On the other hand, the indirect effect through biased assimilation toward inconsistent media was also positive, and statistically significant (*point estimate* = 1.027, *CI* = [.563, 1.499]). That is, higher Partisan News Repertoire index will decrease biased assimilation toward inconsistent media ( $b = -.050, p < .001$ ), and in turn, this had a significantly negative effect on polarization ( $b = -20.495, p < .001$ ). Hence, the findings provided support for H2. The corresponding direct effects were .633 ( $p = .061$ ), showing fully mediated through biased assimilation. In addition, we found that biased assimilation toward inconsistent media had a stronger mediated effect on polarization than biased assimilation toward consistent media.

## Discussion

The high-choice media environment provides people ample opportunities to get news and political information, however, many scholars warned that people may live in echo chambers due to selective exposure and algorithm-based media (Barbera et al., 2015; Dubois & Blank, 2018; Flaxman et al., 2016; Garrett, 2009; Matuszewski & Szabó, 2019; Williams et al., 2015).

Although prior studies tried to explore the presence and the effects of echo chambers, conflicting results emerged because of insufficient and inconsistent measurement (Dubois & Blank, 2018). The current study introduced and found support for polarization in echo chambers that has attracted academically attention—the Partisan News Repertoire Index. We integrated news repertoire approach and biased assimilation theory to examine how different news repertoires may capture particular groups of people into echo chambers in high-choice media environment and what the psychological mechanism lead them to be polarized in echo chambers. Our results revealed two of five news repertoires were mainly driven by political ideology. Approximately forty-two percent people had strong partisan news repertoires which can be divided into pro-green and pro-blue partisan media use, and they may be more likely to live in echo chambers due to their news repertoires with low viewpoint diversity and strong preference for partisan media. Also of importance, people with strong partisan news repertoires tended to be polarized by self-confirming process when encountering consistent partisan media; and also strengthen their prior attitudes through motivated reasoning when exposed to inconsistent partisan media.

In addition to *pro-green* repertoire and *pro-blue* news repertoire, we also found the biggest news repertoire, about thirty-five percent of people, had no partisan orientation in news diets and relied on Social Media, Instant Messaging App, Yahoo, and Google News to get news

and political information. This indicated that social-oriented and algorithm-based media has become the trend for most of people to be informed, and news may be the byproducts of sociality or the main diets. We argued that this repertoire reflected the incidental news exposure phenomenon because social media, search engine, and portal website were not mainly designed for newsy platforms, and people can encounter news accidentally and unintentionally on these media. Hence, people would exhibit sliced and short reading patterns, and their news would be determined by editorial, algorithmic, and social filtering (Boczkowski, Mitchelstein, & Matassi, 2018) rather than ideology, because they had no apparently ideological orientation. Therefore, we criticized the statement that Internet and social media may capture people into echo chambers due to partisan selective exposure and algorithm (Bakshy et al., 2015; Cardenal et al., 2019; Dubois & Blank, 2018). We argued that algorithm is not the main factor but partisan selective exposure is, and partisan selective exposure would further influence the personalization of algorithm, hence, if people with less political interest or no political affiliation, they may be less likely to be in echo chambers.

From a theoretical perspective, the current study contributed to relevant conversations about partisan news repertoire, echo chamber, biased assimilation theory, and polarization. We found the main factor of echo chamber was partisan news repertoire, and polarization was driven by the perceptions of ingroups and outgroups through biased assimilation. That is, when people lived in an echo chamber where they continuously heard like-minded and one-sided viewpoints (e.g., *pro-green* repertoire and *pro-blue* repertoire), the encounter of inconsistent and consistent partisan media would increase polarization by self-confirming and motivated reasoning processes. Rather than showing co-occurrence of echo chamber phenomenon, we provided evidence of causal relationships. It is noteworthy that we extended biased assimilation theory

that motivated reasoning had stronger effects on polarization than self-confirming process.

Existing literature rarely compared the polarized effects between consistent information and inconsistent information (Boysen & Vogel, 2007; Dursun & Tümer Kabadayi, 2013; Lord et al., 1979; Munro et al., 2002), we compared the difference by integrating in a same model.

Furthermore, our results shed the lights on the long-term debates between public sphere scenario and echo chamber arguments. In the line of public sphere scenario often held optimistic view and argued that individuals' attitudes will tend to be more tolerant and moderate when they encountered cross-cutting information and diverse viewpoints (Mutz, 2002; Wojcieszak & Mutz, 2009); on the other hand, others suggests that Internet and social media would generate echo chambers and reinforce individuals' prior attitudes because selective exposure and algorithm (Bakshy et al., 2015; Cardenal et al., 2019; Dubois & Blank, 2018). Consistent with Shmargad & Klar (2019), we argued that the individuals' past media environment experience determined their attitudes toward consistent and inconsistent information. The echo chamber-like environment would reinforce a particular voice and frame peoples' viewpoints about public affairs, and hence generate polarization when exposed to self-confirming information and disconfirming information. Therefore, we argued that in the real world, ideological segregation would enlarge the cognitive gap about controversial issues and damage the function of democracy if people lived in echo chambers.

The results presented here had important implications for methodological understanding of how to measure echo chamber in high-choice media environment. Unlike using variables based on selective exposure behaviors (Dubois & Blank, 2018; Karlsen et al., 2017) and relying on single-platform study (Colleoni et al., 2014; DeVicario et al., 2016; Matuszewski & Szabó, 2019; Williams et al., 2015), the current study adopted a news repertoire approach and developed

the Partisan News Repertoire Index to test the antecedent and consequence of echo chambers. By extending the measurement of partisan selective exposure and cross-media exposure (Muddiman et al., 2014; Stroud, 2010), Partisan News Repertoire Index also considered the influence of algorithm-based media and the viewpoint diversity. Although it was difficult to identify how algorithm work, we depended on the basic logic of algorithm—personalization, which reflected individuals' ideological preference by digital traces (Karimi et al., 2018; Thurman & Schifferes, 2012). Hence, based on the ratio of partisan media use, we calculated the impact value of algorithm-based media. Regarding viewpoint diversity, a prominent characteristic of echo chambers was that a single viewpoint dominated the marketplace of ideas. Based on the idea that partisan media preferred to highlight particular agendas and viewpoints to benefit preferred causes, ideology and political figures (Chan & Lee, 2014; Muddiman et al., 2014), we used common diversity index—HHI to measure how the share of partisan media use influence viewpoint diversity. For instance, *Balanced Omnivores* repertoire and *Light-Blue Omnivores* repertoire had less opportunities to become echo chambers because of high viewpoint diversity.

Furthermore, the current study conducted latent class analysis (LCA) to identify news repertoire rather than traditional cluster analysis. Unlike two-step analysis using principal components analysis and cluster analysis to identify news repertoire (Edgerly, 2015; Edgerly et al., 2018; Ksiazek et al., 2019), the advantages of LCA included offering the relative size of the latent classes, be able to characterize the nature of the latent classes, and denoting respondents into the latent classes (Porcu & Giambona, 2016). Hence, we argued that LCA was an efficient analytical tool to examine the latent class by categorical data and test the causal relationships underlying these latent class.

There are a few limitations that should be acknowledged. First, like prior studies using partisan media or ideologically consistent accounts as proxy to measure the presence of echo chambers (Boutyline & Willer, 2017; Jacobson et al., 2016; Matuszewski & Szabó, 2019), the Partisan News Repertoire Index also focused on the partisan selective exposure rather than partisan news exposure itself. Second, we focused on the sample with news exposure experience on the national survey data, that is, we screened out news avoiders. Although prior studies has shown the specific repertoire of news avoiders had less political participation and political interest (Edgerly et al., 2018; Ksiazek et al., 2019), the current study argued that news avoiders may interfere our results when examining the causal relationship of echo chambers. Third, algorithm is very complicated that overlapping multiple factors, such as users' preferences and their digital traces, interaction with social ties, advertisements, and computer algorithm (Bakshy et al., 2015; Thorson & Wells, 2016). According to the findings of Bakshy et al. (2015), they found individuals' political affiliations played an important role in the presentation of ideological information on Facebook, hence, we focused on the ratio of partisan media use in order to capture the personal preferences on algorithm-based media.

Our results also suggested several opportunities for future research. First, the measurement of Partisan News Repertoire Index provided researchers to test more causal relationships related to echo chambers, such as the relationship between demographics and the formation of echo chamber, or the association with echo chambers and political participations. It would shed lights on political implications of echo chambers. Second, Stroud (2010) found the recursive relationship between partisan selective exposure and polarization, but little is known about whether polarized people are more likely to live in echo chambers. We suggest future study to use longitudinal data to examine the reverse causal direction.

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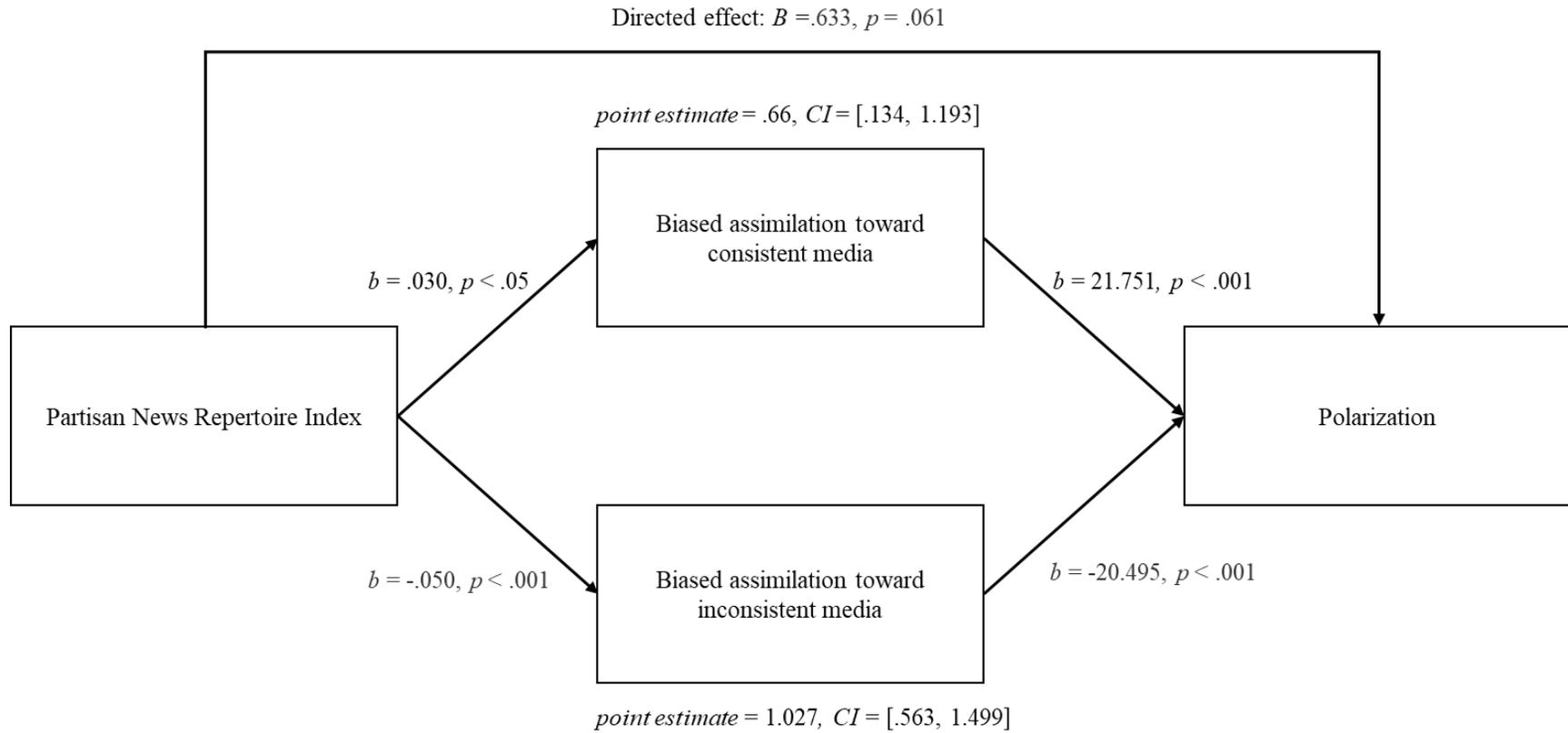
**Table 1***Characteristics and Partisan News Repertoire for Five Classes*

News repertoire	Sample size	News components	B	G	N	A	HHI	PNRI
Class 1 ( <i>Pro-Blue</i> )	245 (12.7%)	TVBS News, Yahoo	1	0	0	1	1	2
Class 2 ( <i>Nonpartisan Aggregators</i> )	686 (35.6%)	Social Media, Instant Messaging App, Yahoo, Google News	0	0	0	4	0	0
Class 3 ( <i>Balanced Omnivores</i> )	217 (11.3%)	TVBS News, Social Media, Instant Messaging App, Yahoo, Apple Daily Website, ETtoday, Google News, United Daily News Website	2	2	0	4	.5	0
Class 4 ( <i>Pro-Green</i> )	569 (29.5%)	Liberty Times, FTV News	0	2	0	0	1	-2
Class 5 ( <i>Light-Blue Omnivores</i> )	209 (10.9%)	Liberty Times, Apple Daily, United Daily News, China Times, TVBS News, Social Media, Instant Messaging App, Yahoo, Apple Daily Website, ETtoday, Google News, United Daily News Website, China Times Website	5	4	0	4	.51	.73

*Note.* HHI indicates the Herfindahl-Hirschmann Index, B/G/N/A indicates the total number of blue media/green media/neutral media/algorithm-based media, and PNRI indicates Partisan News Repertoire Index in the news repertoire.

**Figure 1**

*Indirect Effects of Partisan News Repertoire Index on Polarization.*



**APPENDIX****A.1 Evaluation of partisan news outlets**

	News outlets	Political orientation	
Newspaper			
p1	Liberty Times	Pro-Green Media	自由時報
p2	Apple Daily	Pro-Green Media	蘋果日報
p3	United Daily News	Pro-Blue Media	聯合報
p4	China Times	Pro-Blue Media	中國時報
Television			
tv1	TVBS News	Pro-Blue Media	TVBS 新聞台
tv2	FTV News	Pro-Green Media	民視
Tv3	SET TV	Pro-Green Media	三立新聞台
tv4	ETTV News	Pro-Green Media	東森新聞台
tv5	CtiTV News	Pro-Blue Media	中天電視台
tv6	CTV	Pro-Blue Media	中視
tv7	TTV	Pro-Green Media	台視
Online news			
net1	Social Media	-	社群媒體
net2	Instant Messaging App	-	通訊媒體
net3	Yahoo	-	奇摩
net4	Apple Daily Website	Pro-Green Media	壹蘋果
net5	ETtoday	Pro-Green Media	ETtoday
net6	Google News	-	谷歌
net7	News Aggregator App	-	整合 app
net8	United Daily News Website	Pro-Blue Media	聯合新聞網
net9	China Times Website	Pro-Blue Media	中時電子報
net10	Liberty Times Website	Pro-Green Media	自由時報

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net11	Nownews	Pro-Green Media	Nownews
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*Note.* Social media, Instant Messaging App, Yahoo, Google News, Google News, and News

Aggregator App do not belong to partisan media, because the content presentation of these media rely on preferential algorithm.

**A.2 Conditional probabilities for five news repertoires**

		Class 1 <i>(Pro-Blue)</i>	Class 2 <i>(Nonpartisan Aggregators)</i>	Class 3 <i>(Balanced Omnivores)</i>	Class 4 <i>(Pro-Green)</i>	Class 5 <i>(Light-Blue Omnivores)</i>
p1	No	.84	.86	.98	.75	.44
	Yes	.16	.14	.02	<b>.25</b>	<b>.56</b>
p2	No	.94	.89	.99	.92	.33
	Yes	.06	.11	.01	.08	<b>.67</b>
p3	No	.89	.96	1.00	.87	.63
	Yes	.11	.04	.00	.13	<b>.37</b>
p4	No	.97	.98	1.00	.94	.67
	Yes	.03	.02	.00	.06	<b>.33</b>
tv1	No	.00	1.00	.64	1.00	.78
	Yes	<b>1.00</b>	.00	<b>.36</b>	.00	<b>.22</b>
tv2	No	1.00	.91	.92	.68	.95
	Yes	.00	.09	.08	<b>.32</b>	.05
tv3	No	1.00	.89	.93	.85	.92
	Yes	.00	.11	.07	.15	.08
tv4	No	1.00	.82	.93	.89	.88
	Yes	.00	.18	.07	.11	.12
tv5	No	1.00	.89	.97	.87	.92
	Yes	.00	.11	.03	.13	.08
tv6	No	1.00	.93	.99	.88	.94
	Yes	.00	.07	.01	.12	.06
tv7	No	1.00	.93	.99	.95	.98
	Yes	.00	.07	.01	.05	.02
net1	No	.88	.71	.43	.99	.59
	Yes	.12	<b>.29</b>	<b>.57</b>	.01	<b>.41</b>
net2	No	.83	.68	.55	.97	.67
	Yes	.17	<b>.32</b>	<b>.45</b>	.03	<b>.33</b>

net3	No	.73	.53	.50	.96	.48
	Yes	<b>.27</b>	<b>.47</b>	<b>.50</b>	.04	<b>.53</b>
net4	No	.98	.84	.50	1.00	.69
	Yes	.02	.16	<b>.50</b>	.00	<b>.31</b>
net5	No	.94	.83	.37	1.00	.65
	Yes	.06	.17	<b>.63</b>	.00	<b>.35</b>
net6	No	.86	.74	.57	.97	.63
	Yes	.14	<b>.26</b>	<b>.43</b>	.03	<b>.37</b>
net7	No	.98	.94	.86	1.00	.88
	Yes	.02	.06	.14	.00	.12
net8	No	.97	.97	.72	1.00	.77
	Yes	.03	.03	<b>.28</b>	.00	<b>.23</b>
net9	No	1.00	.99	.82	1.00	.80
	Yes	.00	.01	.18	.01	<b>.20</b>
net10	No	.99	.97	.85	1.00	.93
	Yes	.01	.03	.15	.00	.07
net11	No	1.00	.98	.83	1.00	.89
	Yes	.00	.02	.17	.00	.11

*Note.* Sample size is 245 (12.7%), 686 (35.6%), 217 (11.3%), 569 (29.5%), and 209 (10.9%) for Class 1, Class 2, Class 3, Class 4, and Class 5, respectively. The entries represent the conditional probabilities of response categories (Yes/No) for each class; those in bold represent the response categories that best describe each class.