SERENDIPITOUS NEWS DISCOVERY INCREASES NEWS CONSUMPTION IN NEWS RECOMMENDER SYSTEMS

by

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ABSTRACT

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News recommender system users obtain news via incidental exposure to news and experience serendipity in the incidental news consumption. Serendipitous news discovery, the same as serendipity, refers to discovering unexpected and useful information unintentionally. Researchers suggest building serendipitous news recommender systems and increasing serendipitous news discovery to increase the diversity of the news consumption. However, the impacts of serendipitous news discovery on news consumption are uninvestigated, and rare research provides theoretical guidance to the serendipitous news recommender systems. The thesis investigated the impacts of serendipitous news discovery on news consumption with a serendipity-related emotion, surprise, as a mediator and need for activation as a moderator. 463 participants recruited from Amazon MTurk completed the online survey-experiment. The findings suggest that surprise mediates the correlations between serendipitous news discovery and news consumption.

Users who experience higher serendipitous news discovery indicate more positive attitudes on news consumption in the news recommender systems. The results also indicate the possibility that the lack of constant serendipitous news discovery may lead to the consumption of the news similar to the news that trigger serendipity. The research suggests that serendipitous news discovery increases news consumption, including news selection and reading.

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News recommender systems recommend news articles to users to assist in daily information acquisition. Recommended news information is content that either consistent with users' interests or content that increases novelty, serendipity, and diversity in line with the setting of the algorithm. Personalized news recommendations that suggest content similar to users' reading history cause concerns of the filter bubble and echo chamber. The approach of enhancing serendipity, which refers to discovering unexpected and useful information unintentionally, is proposed to combat the possible filter bubble (Pardos & Jiang, 2019) and echo chamber (Fletcher & Nielsen, 2018b) and increase the diversity of news consumption in recommender systems. Abundant algorithms are designed to enhance serendipity in recommender systems (Deshmukh et al., 2019; Kotkov, Veijalainen, & Wang, 2018; Wang, Deng, Lai, & Yu, 2019; Yang, Xu, Wang, Han, & Yu, 2018). Research illustrates principles to enhance serendipity and impacts of serendipitous news discovery on diversified news consumption. For example, news information that surprises users contributes to the occurrence of serendipity (Niu, Abbas, Maher, & Grace, 2018). The automatic serendipity within search engines leads to the consumption of more sources of online news (Fletcher & Nielsen, 2018b).

In addition to the serendipitous recommender systems, Internet users' news consumption habits contribute to serendipitous news discovery, as well. Internet users are informed of news information by being incidentally exposed to online news (Yadamsuren & Erdelez, 2011). Serendipitous news discovery occurs in the incidental exposure phase, as one approach to obtain news information, and sheds lights on how users select news articles that they would like to read when they are exposed to news headlines in recommender systems. The research of serendipitous news discovery will also establish a theoretical basis for serendipitous recommender systems design and enhance the understanding of incidental news consumption.

The thesis adopts the framework of the activation model of information exposure (Donohew, Palmgreen, & Duncan, 1980) to explore the impacts of serendipitous news discovery on news consumption. The activation model states that emotions are elicited by messages and predict information exposure preference. The need for activation, which is conceptualized as the novel seeking intention, moderates the process of emotional arousal. The thesis adapts the activation model to the recommender system context and proposes that serendipitous news discovery elicits emotions, and the elicited emotions predict news consumption. In addition, the thesis also replicates the previous study on the existence of serendipitous news discovery (also called serendipity) in recommender systems.

The current research offers an approach to studying serendipitous news discovery in recommender systems. The research has fourfold contributions: it 1) explores the impacts of serendipity-related emotions on news reading patterns and system usage; 2) expands the activation model of information exposure to emotion research and communication technology research; 3) proposes a method to study serendipitous news discovery experimentally in recommendation systems; 4) offers practical advice to users and technology companies on how recommender systems help users filter and select news information, and what factors impact users' preferences of news consumption.

News Consumption in Recommender Systems

News consumption in recommender systems includes liking, commenting and sharing the news, as well as reading news and searching for similar news. The news consumption in recommender systems also contains media selection, such as whether users would like to consume and continue consuming news information from the serendipitous recommender systems.

News consumption in recommender systems is shaped by both the algorithm settings of the recommender systems and users' reading habits. Three major news recommender systems include content-based recommender systems, which recommend contents similar to users' reading history, collaborative filtering recommender systems, which recommend contents based on the preferences of similar users (Ricci, Rokach, Shapira, & Kantor, 2011), and hybrid-based filtering recommender systems, which are the combination of the first two systems.

Recommendation approaches of news recommender systems are not public and transparent, but researchers have found clues from recommendation system studies and recommended content. For instance, the hybrid-based filtering approach, which combines both content-based filtering and collaborative filtering approaches, is widely used in social media recommendation systems (Anandhan, Shuib, Ismail, & Mujtaba, 2018). Twitter ranks news information following the popularity and relevance of the information (Jonnalagedda, Gauch, Labille, & Alfarhood, 2016).

General features of news recommendation systems also impact the information seen by users and news consumption. For example, users choose to read more articles when the explicit recommendation is available, and spend more time on articles with stronger explicit recommendations (Knobloch-Westerwick, Sharma, Hansen, & Alter, 2005), and participants read more most-viewed articles in recommendation systems when being reminded of the explicit recommendations (Yang, 2016).

Certain recommender systems, such as social media sites, also promote online news consumption. Social media users are more likely to be exposed to information with longer time on social media (Ahmadi & Wohn, 2018). Even users who do not regard social media as news platforms consume more content on social media than non-users, and the effects are stronger for

younger people, users with low interest in news, and Twitter users compared with Facebook users (Fletcher & Nielsen, 2018a).

In addition, incidental exposure to online news becomes a common way for users to be informed about the information (Yadamsuren & Erdelez, 2011). News recommender system users do not usually look for news intentionally and are involved in incidental news consumption to obtain news information from news recommender systems. The news-finds-me perspective is proposed to describe the phenomenon that users expect to encounter information without active seeking behavior on social media (Gil de Zúñiga, Weeks, & Ardèvol-Abreu, 2017).

Serendipitous News Discovery in Recommender Systems

Serendipitous news discovery refers to discovering unexpected and useful information unintentionally. Users encounter serendipity when they discover information that is correlated with their information interests (De Bruijn & Spence, 2008) and prior concern or information need (Rubin, Burkell, & Quan-Haase, 2010). The serendipity experience is described to be unexpectedness, insight, value, and preoccupation (Bogers & Björneborn, 2013). Serendipitous information offers new perspectives, extends prior thinking (Rubin et al., 2010), and impacts news consumption.

Serendipitous news discovery is often connected to information seeking and scanning. Serendipitous information seeking, proposed by Twidale, Nichols, and Paice (1997), demonstrates the correlation between information seeking and serendipity. One similar definition--information encountering--proposed by Erdelez (1999), also stresses the accidental discovery of information within active searching. Rice, McCreadie, and Chang's (2001) study indicates that serendipity may also happen in the information scanning process. Case (2007) even lists serendipity as a special type of information scanning. Serendipitous news discovery occurs

in both the news information seeking and scanning process. Considering that information scanning is one common news consumption approach in news recommender systems, the thesis looks at the serendipitous news discovery associated with information scanning in the recommender systems.

News recommender systems settings and the incidental news consumption approach both increase the likelihood of serendipity. News recommender systems recommend content to users. Scholars postulate that novelty and diversity also constitute a high-quality recommender system (Kaminskas & Bridge, 2016) and suggest to increase serendipity in recommender systems (De Gemmis, Lops, Semeraro, & Musto, 2015; Deshmukh et al., 2019; Iaquinta et al., 2008; Kotkov, Veijalainen, & Wang, 2016). Piao and Whittle's (2011) study demonstrates the feasibility of identifying and promoting serendipitous content on Twitter. Sun, Zhang and Mei's (2013) study also reveals the existence of serendipity on Twitter. Furthermore, incidental news consumption also contributes to serendipitous news discovery. Users encounter serendipity when incidentally being exposed to new or novel information (Van Damme, Martens, Van Leuven, Vanden Abeele, & De Marez, 2019). That is, news recommender system users get recommended news information intentionally or incidentally from recommender systems and the possibility of encountering unexpected, novel news information increases.

Serendipitous news discovery is believed to be a solution to filter bubble and echo chamber concerns that are associated with news recommender systems. The filter bubble (Pariser, 2011) suggests that users will only encounter information that is consistent with their beliefs with the aid of news recommender systems and their previous beliefs will be reinforced. The echo chamber (Sunstein, 2007) describes the situation that users' beliefs are amplified within the closed system, such as a news recommender system. Those two concerns point out

that users are exposed to the same type of news information according to their prior reading history and are trapped in a closed system. News recommender systems that increase serendipity assuage those worries via bringing in divergent news information. Compared with reading the same type of news information, users who experience serendipitous news discovery encounter unexpected and useful information, learn new perspectives of topics they might have known and discover new information. The existence of serendipitous news discovery disputes the view of the filter bubble and echo chamber.

The Activation Model of Information Exposure

The activation model of information exposure (Donohew et al., 1980) contains a two-stage paradigm. The first stage deals with emotion-elicited situations, where emotions are elicited in attitudinal, importance, and need conditions, while the second stage predicts information exposure preference given the elicited emotions. The model postulates that 1) individuals with diverse needs for activation react differently to importance and discrepancy, and generate arousal in diverse levels, 2) the emotion arousal impact preferences of continued exposure to information. The need for activation is conceptualized as novelty seeking intentions in Donohew et al.'s (1980) study. The activation model has been used to explain and guide health campaigns in health communication, such as smoking prevention campaign for adolescents (Helme, Donohew, Baier, & Zittleman, 2007), individual effects of messages on young adults' health information processing (Xu, 2015) and cancer prevention and treatment (Stephenson & Southwell, 2006). The thesis examines serendipitous news discovery and the impacts on news consumption under the framework of the activation model of information exposure.

The activation model proposed that individuals with higher needs for activation expect to

be aroused by important and discrepant messages and that the arousal contributes to more positive affect. Correspondingly, for individuals with a lower need for activation, being exposed to important topics contributes to more arousal and more negative affect. Individuals with a diverse need for activation behave differently facing important/unimportant and discrepancy/supportive messages and their preference for being continuous exposure to messages varies. The explanation of the diverse reactions is that individuals with higher needs of activation would be more information hungry than individuals with lower needs.

Following the framework of the activation model of information exposure, the thesis proposes a serendipitous news discovery and news consumption model. Recommender system users read messages, experience serendipitous news discovery and serendipity-related emotions, and increase or decrease exposure to news. The whole process from initial news exposure to subsequent news consumption with elicited emotions is moderated by the need for activation.

Message-Related Emotions and Serendipity-Related Emotions in Recommender Systems

Emotions are important in context-aware recommender systems (Zheng, Mobasher, & Burke, 2016) and impact information consumption. For example, anxiety may increase information consumption on threatening stimuli (Marcus, Neuman, & MacKuen, 2000). Researchers suggest that emotions should be embedded in recommender systems (González, De La Rosa, Montaner, & Delfin, 2007). Emotions could be elicited by both the message and the recommender system user experience.

Plenty of research has examined the impacts of message-relevant emotion on message framing, for instance, user exposed to anger frame bias information processing (Kühne & Schemer, 2015), read the news less thoroughly and show more negative attitudes to the company (Kim & Cameron, 2011) than sadness frame. Message-related emotions also exist in gain- and

loss-framed messages and exert persuasive influence (Nabi et al., 2019). Similar to message-related emotions, pre-message emotions also interact with the framed messages. For example, fear is correlated with the behavioral approach system, while happiness and anger trigger the behavioral inhibition system, and gain- and loss-frame produce diverse persuasion impacts for participants with distinct moods (Yan, Dillard, & Shen, 2012). Message-related emotions are triggered by the news information recommended by the recommender systems.

Parallel to emotions elicited by the messages, serendipitous news discovery also induces emotions. Serendipity-related emotions are elicited in the use of recommender systems and impact users' process of information consumption. Serendipity-relevant emotions are elicited due to being satisfied by discovering news items that are consistent with their interests, confirm their beliefs, or comfort their worries (Yadamsuren & Heinström, 2011). Serendipity-related emotions, including surprise (Rubin et al., 2010), perform as pre-message emotions and exert impacts on information processing. As stated in the activation model of information exposure, serendipitous news discovery arouses emotions. Similar to Rubin et al.'s (2011) research, the thesis concentrates on the surprise that is aroused by serendipitous news discovery.

According to the activation model of information exposure, the need for activation is one individual difference factor that moderates the emotion elicitation process. Recommender system users with a higher need for activation have expectations on exploring news information on the system, and serendipity contributes to more positive affect, whereas recommender system users with a lower need for activation are less willing to be exposed to serendipitous information and perceive more negative emotions.

Serendipity-Related Emotions and News Consumption

Serendipity impacts information consumption. For instance, serendipity positively impacts user satisfaction and purchase intention (Chen, Yang, Wang, Yang, & Yuan, 2019). The research on serendipity-related emotions and serendipity experience in recommender systems is scarce, and it is uninvestigated whether serendipity-related emotions, such as surprise, impact news consumption.

The activation model of information exposure indicates that emotions aroused are positively related to intentions of continuously being exposed to the news information, which is the same as intentions of news consumption. Though the activation model of information exposure only mentions future exposure intention of the news, the preferences of consuming news information in the current news recommender systems are included in the thesis.

The activation model also proposes that the need for activation impacts news consumption. In the activation model, individuals with different levels of need for activation show different intentions of future information exposure (news consumption). Similarly, the thesis proposes that the need for activation impacts users' news consumption.

The Model of the Present Study

The activation model of information exposure indicates that emotions will be aroused by stimuli and the emotions will further impact information processing. Recent research reviewed above suggests that browsing news in recommender systems trigger serendipity, arouse emotions and result in changes of intentions, such as purchase intention. The path serendipitous news discovery exerts impacts on intention changes has not been systematically explored. The goal of the current thesis is to propose and test the model that explains the impacts of serendipitous news discovery in the recommender systems.

Under the framework of the activation model and previous studies, serendipitous news discovery is correlated with certain emotions, in particular surprise. No previous research indicates that surprise exerts impacts on news consumption, thus the impacts of surprise on news consumption are proposed as a research question. Second, serendipitous news discovery and surprise impact news consumption in line with the activation model. One more component in the activation model is the moderator the need for activation. The activation model proposes that the need for activation represents the information hunger level, impacts the impacts of serendipitous news discovery on emotion arousal and further impacts news consumption. The proposed theoretical diagram is as follows (Figure 1).

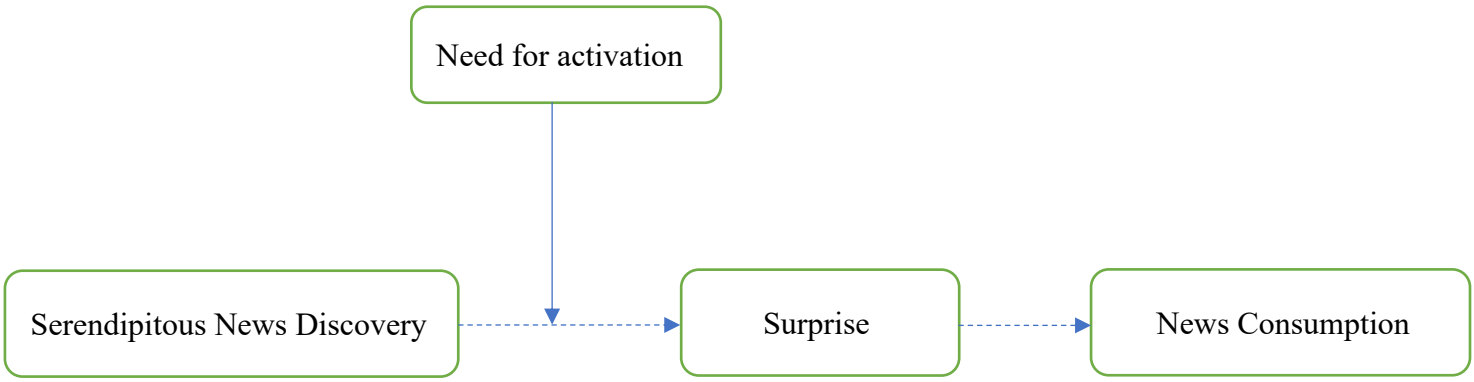

Figure 1. The proposed model of serendipity

Method

Pre-test

A pre-test was completed one month before the survey-experiment. The pretest aimed at selecting experimental materials for each condition in the survey-experiment. Participants (N = 124) who indicated agreement with the consent form were asked to select one out of two topics (climate change and genetically modified organisms) that they were interested in and were

randomly assigned to one out of two conditions under that topic. Two conditions under each topic contained the same must-read article and five articles that were relevant to the must-read article recommended by two diverse recommender systems (Twitter and Quartz). Each condition contained five articles recommended by one recommender system. In each condition under the same topic, participants read the same must-read article first, rated the relevance level of the must-read article, and read five more articles related to the must-read article (described below). The sequence of the five articles was assigned randomly. After each article, participants rated the level of serendipitous news discovery.

The three articles with the highest score of serendipitous news discovery in each condition were used as experimental materials. The average score for serendipitous news discovery in condition 1 under topic climate change was 20.97 ($N = 41$, $SD = 3.51$). The average score for serendipitous news discovery in condition 2 under topic climate change was 17.43 ($N = 47$, $SD = 5.47$). The average score for serendipitous news discovery in condition 1 under topic GMOs was 23.29 ($N = 7$, $SD = 3.67$). The average score for serendipitous news discovery in condition 2 under topic GMOs was 19.00 ($N = 5$, $SD = 5.44$).

One hundred and twenty-four participants (over 18 years old) were recruited on March 3rd, 2020 from Amazon MTurk for a pre-test, in which participants rated the serendipitous news discovery level of each articles in one condition. Participants received $0.25 compensation after they completed the survey-experiment and answered the attention check question correctly. Questionnaires that were incomplete or did not include the correct answer to the attention check question were removed. Questionnaires answered by participants with the same IP address and assigned to the same condition were removed. Questionnaires completed by participants with the same IP address but assigned to different conditions or topics were retained. Though subject

must read the same must-read article, they may experience different levels of serendipitous news discovery in different conditions. Finally, one hundred questionnaires remained in the dataset. The mean age was 30.78 (*SD* = 9.33, range 18-65). 66 male participants and 34 female participants participated in the pre-test. The majority of participants reported college (24.5%) and above education level (63.7%). Among all the participants, 12 people selected GMOs, while 88 people selected climate change as the topic they would like to read more about. 7 people read articles from qz.com (Condition 1), and 5 people read articles from Twitter (Condition 2) under the topic GMOs. 41 people read articles from qz.com (Condition 1), and 47 people read articles from Twitter (Condition 2) under the topic climate change.

In the pre-test, participants rated the revised serendipity scale to indicate their serendipitous news discovery from each news article. The four items included "I experienced serendipity on the news I have read that has an impact on my everyday life." "I experienced serendipity on the news I have read that has an impact on my work." "I encountered useful information or resources that I was not looking for when I read the news." and "I encountered mixes of unexpectedness and insight that led to valuable, anticipated outcomes when I read the news." Answers varied from 1(strongly disagree) to 7(strongly agree).

All the news articles included in the survey-experiment were recommended by either qz.com or Twitter. The selection criteria were described below. The two selected topics were climate change and GMOs due to the popularity of the topics and the expertise of the qz.com (explained below).

The first article on climate change was retrieved from Google News. The researcher looked through the sources of the first ten articles returned from the results of "climate change" in Google News. Quartz website was the only website among the list that recommends similar

content to users and is said to be pro-science with its GMOs and climate change news (Media Bias/Fact Check, n.d.). Thus, the climate change article on the Quartz website was selected as the must-read article that each participant has to read, while the GMOs was selected as another topic that participants can read. The headline of the must-read news article was "climate change is already transforming international sports". The five news articles recommended by the Quartz website were either news articles recommended under the must-read news article or the first or second recommended news articles of the must-read news article. Five recommended news articles were collected as experimental materials of the pre-test. Topic irrelevant to climate change on the recommendation list, outdated news (published earlier than 2019), or news articles that did not meet the requirement of the word count (shorter than 400 words, or longer than 600 words) were removed.

The must-read article on the GMOs topic was the second article retrieved from Google News. Keywords of that search was "GMOs Quartz". The first result which introduced a GMOs company in the Quartz at Work section was not picked results from that the aim of the Quartz at Work section was to introduce new companies instead of the topic. The must-read article of GMOs was entitled "Even major food companies hate the new US rules for GMO food labeling". Similar article collection and filtering rules were applied to the second topic. The five recommended articles were either articles recommended below the must-read article or the first or second articles. Articles contained political or brand information were excluded. Most of the articles on GMOs were not published in 2019, thus articles published before 2017 were excluded. Articles selected were around 430-530 words.

Other than personalized news portal, users also obtain news articles from social recommender systems, such as Twitter. Thus, Twitter was selected as another recommender

system that provided recommended news articles in the current study. The must-read news article was given the following tags in the Quartz website: business, science, culture, climate change, economy. The researcher used the advanced search function in Twitter to retrieve similar content. The qualified posts should contain the hashtag #climatechange, as well as any of these words--business, science, culture or economy. The results returned as top tweets in the "top" list are screened and posts with a news article link were selected as experimental materials. The top five qualified news articles were collected as experimental materials in the pretest. A similar strategy was applied to the GMOs topic. Five articles with the hashtag #GMOs, and any of the words—science, food, government, and genetics, were collected as experimental materials. Articles on the climate change topic were around 430-530 words.

Participants

Six hundred participants were recruited from Amazon MTurk to complete the survey-experiment on March 16th and 17th, 2020. The author followed a similar data cleaning strategy as in the pre-test. Questionnaires that were incomplete or did not include the correct answer to the attention check question were removed. Similar to the pre-test, the author also did an IP check. Questionnaires answered by participants with the same IP address and assigned to the same condition were removed. Questionnaires completed by participants with the same IP address but assigned to different conditions under the same topic or different topics were retained. Because two conditions under the same topic only shared the same must-read article and all the other articles were distinguished from each other. Completing the survey multiple times will not significantly impact the serendipitous news discovery and news consumption. Participants who reported have at least read several news from another Amazon HIT were excluded as well (data reported in the data analysis section).

463 questionnaires remained in the final dataset. The age range among all the questionnaires was from 18 to 79 years old. The average age was 36.11 years (*SD* = 12.29). 234 male participants, 225 female participants and 4 participants that reported another gender identity completed the survey. Participants also reported the highest education level: 1 participant (0.2%) reported grade one to eight, 38 participants (8.2%) reported grade nine to twelve, 48 participants (10.4%) reported technical, trade, or vocational school after high school, 121 participants (26.1%) reported college, 176 participants (38.0%) possessed a degree from a 4-year university, and 79 participants (17.1%) reported post-graduate training.

356 participants selected to read articles on climate change. 192 participants were randomly assigned to the Quartz condition, and 164 participants were randomly assigned to the Twitter condition. 107 participants selected to read articles related to GMOs. 44 participants were assigned to the Quartz condition, and 63 participants were assigned to the Twitter condition. There is no way to connect the survey data to the website review data, however, the author checked the traffic of all the four websites and all the traffic is far more than the complete survey answers.

Procedure

In the survey-experiment, participants read the consent form first. Participants who agreed to participate in the survey completed the mood survey and selected one topic they would like to read. Participants then were directed to a news recommender system, designed by the author. Participants were exposed to the must-read news article on the first page of the recommender system. As they read the news, they scrolled down the page and were exposed to three headlines of recommended articles. They were asked to click on one headline that they would like to read, then they were directed to a second page to read the full text of the article.

Participants who completed reading scrolled down, clicked the survey link at the bottom of the page, were directed back to Qualtrics and completed the survey questions regarding their emotions, serendipitous news discovery experience, and news consumption in the news recommender systems.

Materials

To avoid the bias of the content filtering approaches or topics, the news articles under each topic were recommended by two recommender systems, either qz.com (content-based recommender system) or Twitter (hybrid-based recommender system), and participants select one topic either climate change or GMOs. The selection criteria of the two recommender systems, topics and the news articles under each topic were described in the pre-test section. The news articles participants read are either articles recommended by the qz.com or results returned as top posts on Twitter when searched the topic in the hashtag. Three articles with the highest serendipity score in each condition in the pre-test were selected as the final materials (attached in Appendix D).

Stimuli

The first article that each participant read performed as the basic knowledge of the topic, which was consistent with one criterion of serendipity—previous knowledge basis regarding the topic, also called static knowledge base according to Fan and Niu (2018)**.** Another manipulation of the news article was whether it is unexpected and useful, according to the serendipity scale (McCay-Peet, Toms, & Kelloway, 2015).

Measures

Surprise. Surprise was measured by one single statement revised from the state mood measure scale (Cupchik & Gignac, 2007) after experiment measurements. Participants answered

the question "how surprised do you feel". The answer choices varied from 1 (not at all surprised) to 7 (extremely surprised).

Serendipitous news discovery. The perception of serendipity scale of specific digital environment (S-SpecificDE; McCay-Peet et al., 2015) was used to measure serendipitous news discovery. Participants learned the definition of serendipity, which was "serendipity refers to discovering unexpected and useful information," in the instruction of the scale.

The four revised items in the scale included "In the system, I experienced serendipity that has an impact on my everyday life." "In the system, I experienced serendipity that has an impact on my work." "I encountered useful information, ideas, or resources that I was not looking for when I used the system." and "In the system, I experienced mixes of unexpectedness and insight that led to valuable, unanticipated outcomes." (Cronbach's alpha was 0.830). Answers varied from 1 (strongly disagree) to 7 (strongly agree).

News consumption. News consumption was measured by three subscales: news consumption, news consumption in the news recommender systems, and preference for continuous exposure in the news recommender system.

The first news consumption scale included five questions: "How much would you like to READ more news related to what you read?", "How much do you LIKE the news you have read?", "How much would you like to SEARCH FOR more news related to what you read?", "How much would you like to COMMENT on the news you have read?", and "How much would you like to SHARE the news you have read?"(Cronbach's alpha was 0.87. Answers vary from 1 (not at all) to 7 (a great deal). Participants also answered questions on their overall impressions about news reading in the news recommender system. The subscale of news consumption in the news recommender system included the following statement, "How much do

you like news on the news portal?", "How much would you like to READ news on the news portal?", "How much would you like to SEARCH FOR more news on the news portal?", "How much would you like to COMMENT on the news on the news portal?", "How much would you like to SHARE news on the news portal?" Cronbach's alpha was 0.89. Answers vary from 1 (not at all) to 7 (a great deal).

In addition, participants also answered a single question regarding the preference for continuous exposure, adapted from the scale of Donohew, Palmgreen, and Duncan (1980). The statement was "Please rate how much you would like to read news on the news portal." Answers vary from 1 (want very much to stop reading in the system) to 7 (want very much to continue reading in the system). The final measurement of news consumption was the average of the three sub-scales. Cronbach's alpha of the final measurement was 0.94.

The need for activation. Akin to Donohew et al. 's (1980) article, the need for activation was measured by the Novelty Experiencing Scale (Pearson, 1970). The scale contained 80 items and was divided into four subscales, measuring external/internal sensation, and external/internal cognitive. The higher total counts of likes from statements in the subscales indicated higher need for activation. The examples of four subscales included: Exploring the ruins of an old city in Mexico (external sensation), letting myself go in fantasy before I go to sleep (internal sensation), finding out how a carburetor on a car works (external cognitive), and thinking about why people behave the way they do (internal cognitive). Cronbach's alpha was 0.79. (See Appendix B for the questionnaire, see Appendix C for the system design).

Results

Data Analysis

The survey included a question about whether participants attended the pre-test before.

127 participants claimed they have read more than one news in the other Amazon HIT, and 464 said they did not attend the pre-test. An independent samples t-test was conducted and the results indicated a significant difference between the two groups on serendipitous news discovery ($t(232.794) = 6.25$, $p < .001$),three subscales of news consumption including news consumption ($t(285.536)=9.55$, $p<.001$), news consumption in the news recommender systems ($t(295.53)=9.37$, $p<.001$), and willingness to continue consuming news in the news recommender systems *(*$t(273.556)=6.60$, $p<.001$). Thus, participants who claimed to have attended the pre-test were excluded.

The data analysis was completed using SPSS Statistics 26 and PROCESS macro v3.4 (Hayes, 2018). The moderated mediation model analyses were examined by PROCESS (model 7 and model 4). The independent variable was serendipitous news discovery, the dependent variable was news consumption, the mediator was surprise and the moderator was need for activation in the model. The number of bootstrap samples for 95% confidence intervals is 5000. Means, standard deviations, and the correlations between variables were reported in Table 1 (see Appendix A).

Model Test

The results of the moderated mediation model were partial supported (table 2). Serendipitous news discovery was positively correlated to surprise ($b = .15$, $SE = .05$, $p < .01$). Recommender system users with higher surprise indicated a more positive attitude on news consumption ($b = .37$, $SE = .10$, $p < .01$). Recommender system users with higher level serendipitous news discovery were more likely to indicate more positive attitude towards news consumption ($b = .67$, $SE = .04$, $p < .01$). Need for activation did not moderate the correlation between serendipitous news discovery and news consumption. 95% percentile bootstrap CI

[-.0009, .0006] included zero. After getting rid of the moderator of need for activation, the mediation model (table 3) was fully supported ($F(1, 461) = 398.41$, $R^2 = .46$, $p < .0001$). The indirect effect of serendipitous news discovery on news consumption was significant ($b = .05$, $SE = .01$), 95% percentile bootstrap CI [.0198, .0746] did not include zero.

The final model is as follows (Figure 2).

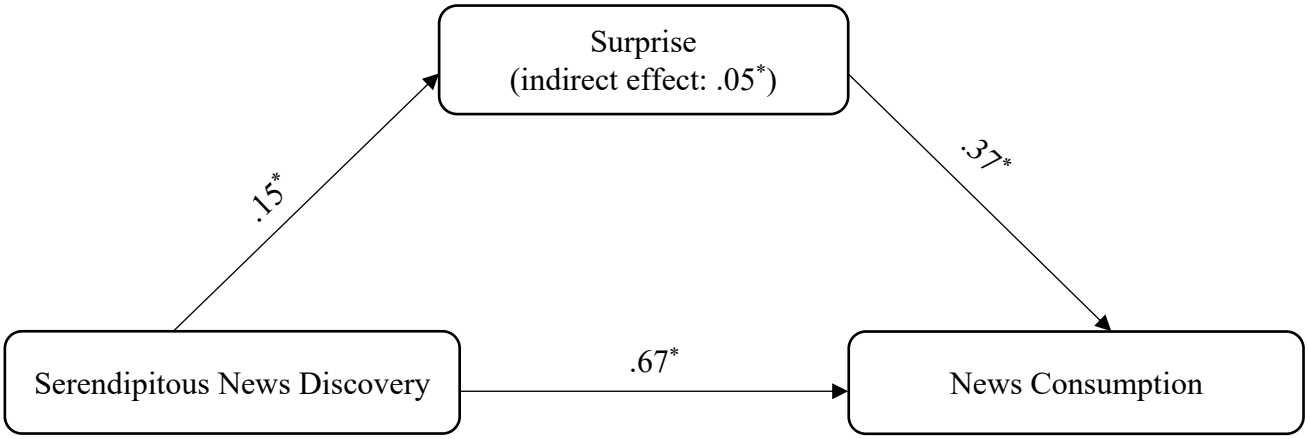

Figure 2. Model of Serendipitous News Discovery

Discussion

The thesis examined the impacts of serendipitous news discovery on the news consumption in the news recommender systems. The method of triggering serendipitous news discovery and results supported the existence of serendipitous news discovery in news recommender systems. Participants reported diverse levels of serendipitous news discovery after reading several news articles in the news recommender systems. The success of the experimental design supported that 1) static knowledge base (Fan & Niu, 2018) and unexpected and useful information (McCay-Peet et al., 2015) trigger serendipitous news discovery, 2) serendipitous news discovery exists on social media sites, such as Twitter, revealed by Sun, Zhang and Mei

(2013), and news recommender systems, like Quartz.com, 3) opportunities of serendipitous news discovery can be increased by the manipulation of recommended content, like suggested by Piao and Whittle (2011). The finding also supports that serendipitous news discovery exists in the information scanning process when being exposed to new or novel information (Van Damme et al., 2019).

The thesis found that serendipitous news discovery arouses surprise. The finding supports Rubin et al.'s (2010) research that serendipity triggers surprise. The thesis then found higher arousal of surprise is positively correlated to more news consumption regarding similar news and more news consumption in the news recommender systems and higher willingness to continue consuming news in the recommender systems. Rare research examines the impacts of serendipity-related emotions on news consumption; the thesis filled the gap and suggested that people who experience higher surprise in the news reading experience are more likely to consume similar news in the same news recommender systems and would like to continue consume news information in the same news recommender systems.

However, the findings indicate a potential outcome of serendipitous news discovery that participants are more likely to read similar news as the news that trigger serendipity. Serendipity is proposed to solve the possible echo chamber and filter bubble problem, while it also leads to possible echo chamber and filter bubble issues. After users experience serendipitous news discovery, they tend to read news that are similar to the news that trigger serendipity. Then the topic began the news that they are familiar with and new serendipity won't be created by the same type of news. The finding reminds that news recommender systems should be designed to include constant serendipitous news discovery.

The findings also supported that surprise mediates serendipitous news discovery and

news consumption. Serendipitous news discovery increases surprise and impacts news consumption. Users who experience higher level of serendipitous news discovery and surprise are more likely to consume more news in the same recommender systems. The findings echo the suggestion to increase serendipity in recommender systems, suggested by De Gemmis, Lops, Semeraro, and Musto, (2015), Deshmukh et al., (2019), Iaquinta et al., (2008), and Kotkov, Veijalainen, and Wang, (2016).

The moderation effects of need for activation between serendipitous news discovery and surprise is not supported. The need for activation is not correlated to surprise or news consumption. The finding contradicts the activation model of information exposure. One possible explanation is surprise as an emotion is not equivalent to information importance or discrepancy. The novelty experiencing scale only measures expectations of activities in external sensation, internal sensation and external cognitive sub-scales, and interests of learning interactions in the internal cognitive sub-scale. Surprise does not fall into the scope of novelty experiencing.

The thesis proposed a theoretical model of serendipitous news discovery to explain how serendipity impacts news consumption. Serendipitous news discovery positively impacts news consumption in the news recommender systems directly and indirectly through surprise. The model indicates the correlations between serendipitous news discovery and news consumption and suggests to pay attention to the news consumption accompanying serendipitous news discovery that people tend to read similar news and remain constant serendipitous news discovery in the news recommender systems. The serendipity model supports the rationality of serendipitous recommender systems design and provides theoretical guidance. Users who experience higher level more serendipitous news discovery in the news recommender systems

indicate more positive attitudes on consuming news and are likely to consume news information in the recommender system.

The thesis sheds lights on serendipitous news discovery and incidental news exposure research. Serendipitous news discovery, a novel news consumption approach developed in the information scanning process, explains that users may consume certain news due to the unexpected and valuable attributes of the news information. This thesis directly stimulated serendipitous news discovery with news articles and allowed researchers to observe the impacts of serendipitous news consumption. Compared to previous studies that invited participants to imagine the serendipity experience in a survey, this thesis triggered serendipitous news discovery using articles recommended by different recommendation systems. The method can be utilized in more serendipity research to directly observe the impacts of serendipitous news discovery.

However, the generalization of the results to all of the news recommender systems should be cautious. The thesis was conducted with two topics from two news recommender systems. To generalize the results, future research could replicate the experiment using experimental materials on different topics or from diverse news recommender systems. Future research directions also include 1) exploring how frequencies of serendipitous news discovery impact daily news consumption, 2) exploring whether other emotions are associated with serendipitous news discovery and how those emotions impact news consumption.

Conclusion

The thesis proposed a serendipity model and indicates that serendipitous news discovery arouses surprise, and further impacts news consumption. Users who experience higher serendipitous news discovery indicate a more positive attitudes on the news consumption in the news recommender systems. The results also indicate the possibility that the lack of constant

serendipitous news discovery may lead to the consumption of similar news. The experimental design allows researchers to trigger serendipity in online environment and observe the news information selection after experiencing serendipitous news discovery. The research contributes to the understanding of incidental news exposure and news consumption.

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APPENDIX A:

Mean, Standard Deviations and Correlations

Table 1. Means, standard deviations and correlations between study variables.

	Mean	**SD**	2.00	3.00	4.00	5.00	6.00	7.00	8.00
1. surprise	36.16	1.86	.329**	.340**	0.00	-0.08	-.122**	0.01	.134**
2. serendipitous news discovery	18.04	5.06		.681**	.164**	-0.04	0.00	0.00	.162**
3. news consumption	15.55	5..31			.231**	-0.05	-0.07	0.03	.226**
4. need for activation	51.94	14.74				-.142**	-.115*	.093*	0.04
5. age	36.11	12.29					.146**	-0.06	-.166**
6. gender	1.50	0.52						-0.07	-.103*
7. education	5.45	1.15							0.08
8. race	1.67	1.10							

Note.
gender ranged from 1-3;
Other measurements ranged from 1-7.
** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

APPENDIX B:

Results of the Moderated Mediation Model

Table 2 Results of the Moderated Mediation Model		
Variable	Unstandardized Regression Coefficients	Standard Error
Direct effects		
Serendipitous news discovery-surprise	0.15*	0.05
Surprise-news consumption	0.37*	0.10
Serendipitous news discovery-news consumption	0.67*	0.04
Indirect effects		
Serendipitous news discovery*need for activation-surprise	0.00	0.02

APPENDIX C:

Results of the Mediation Model

Table 3 Results of the Mediation Model		
Variable	Unstandardized Regression Coefficients	Standard Error
Direct effects		
Serendipitous news discovery-surprise	0.12*	0.02
Surprise-news consumption	0.37*	0.10
Serendipitous news discovery-news consumption	0.67*	0.04

APPENDIX D:

Questionnaire

[consent form]

Would you like to participate in this study?
I understand the information above and agree to participate in this study.
I do not agree to participate in this study.

What is your age?
___age
[Participants less than 18 years old will be kicked out of the system politely.]

State Mood Measure (Cupchik & Gignac, 2007)
Please tell us how you feel at this moment by answering the following questions. The scale ranges from 1 = not at all to 7 = extremely.
1. How relaxed are you?
2. How bored are you?
3. **How agreeable are you?**
4. **How calm are you?**
5. **How sad do you feel?**
6. **How angry do you feel?**
7. **How anxious do you feel?**
8. **How happy do you feel?**
9. **Do you feel guilty about something?**
10. **How surprised do you feel?**

[Participants read the must read article]
Instructions for the pre-test:
Please select one topic that might be of interest and you will be reading several articles related to that topic.
1. Climate Change.
2. GMOs.
(After participants select one topic)
You will read one article first and answer questions regarding the relevance of the article.

Instructions for the formal experiment:
Please select one topic that might be of interest and you will be reading several articles related to that topic.
1. Climate Change.
2. GMOs.
(After participants select one topic)
You will read one article first.

[Participants scan through the three articles and select one to read]
Please read through the headline of the three recommended articles and read one article that interests you by clicking on the headline of that article. After reading the article, you will be directed to a questionnaire

and answer several questions regarding your news reading experience, personality and demographic information.

Instruction (It is same in all four conditions)

Please click the following link to a news portal and read one article first. After finishing reading the first article, please pick and read one recommended article following the instructions below the article. After reading the article, you will be directed to a questionnaire and answer several questions regarding your news reading experience, personality and demographic information.

First, please click the link www.newsportal.com **to the news portal and read the article on the news portal.**

If you have read two articles on the news portal, please click the next button to answer questions regarding your news reading experience, personality and demographic information.

State Mood Measure (Cupchik & Gignac, 2007)
Please tell us how you feel at this moment by answering the following questions. The scale ranges from 1 = not at all to 7 = extremely.
1. How relaxed are you?
2. How bored are you?
3. **How agreeable are you?**
4. **How calm are you?**
5. **How sad do you feel?**
6. **How angry do you feel?**
7. **How anxious do you feel?**
8. **How happy do you feel?**
9. **Do you feel guilty about something?**
10. **How surprised do you feel?**

Instruction for pre-test:
You will be reading five recommended articles from a news portal. Please read each article and answer several questions regarding the news reading experience. You will also answer demographic information at the end of the survey.

Serendipity scale for the pre-test:
The perception of serendipity scale of specific digital environment (S-SpecificDE) (McCay-Peet et al., 2015)**.**
Please tell us your experience of serendipity regarding the news you have read. Serendipity refers to discovering unexpected and useful information.
I experienced serendipity that has an impact on my everyday life on the news I have read.
I experienced serendipity that has an impact on my work on the news I have read.
I encountered useful information, ideas, or resources that I was not looking for.
I experienced mixes of unexpectedness and insight that lead to valuable, unanticipated outcomes on the news I have read.

The perception of serendipity scale of specific digital environment (S-SpecificDE) (McCay-Peet et al., 2015)**.**
Please tell us your experience of serendipity on the news portal. Serendipity refers to discovering unexpected and useful information.
I experienced serendipity that has an impact on my everyday life on the news portal;
I experienced serendipity that has an impact on my work on the news portal;
I encountered useful information, ideas, or resources that I was not looking for when I use the news portal;
I experienced mixes of unexpectedness and insight that lead to valuable, unanticipated outcomes on the news portal.

Reading experience
The following questions concerning the impressions of the news you have read on the news portal. Please select one option that best describe your experience. Answer varies from 1 = not at all to 7 = a great deal.
How much would you like to READ the news you have read?
How much do you like the news you have read?
How much would you like to SEARCH FOR more news related to the news you have read?
How much would you like to COMMENT on the news you have read?
How much would you like to SHARE the news you have read?
The following questions will ask your overall impressions of news reading on the news portal. Please select one option that best describe your experience. Answer varies from 1 = not at all to 7 = a great deal.
How much do you like news on the news portal?
How much would you like to READ news on the news portal?
How much would you like to SEARCH FOR more news on the news portal?
How much would you like to COMMENT on the news on the news portal?
How much would you like to SHARE news on the news portal?

Preference of continuous exposure (Donohew, Palmgreen, & Duncan, 1980)
Please rate how much you would like to read news on the news portal. Answer ranges from 1= "want very much to stop reading on the news portal" to 7 = "Want very much to continue reading on the news portal".
How much would you like to read the news on the news portal?

Novelty experiencing scale (Pearson, 1970)
Listed below are a series of statements that describe things you might do or experiences you might have. Below each statement you are to indicate, by clicking Like or Dislike, whether you like or dislike the activity described by the statement. Work rapidly and give your first impression.
External Sensation
1. Exploring the ruins of an old city in Mexico
2. Being on a raft in the middle of the Colorado River
3. Riding on a sled in Alaska pulled by huskies
4. Scuba diving in the Bahamas
5. Being at the top of a roller coaster ready to go down

6. Sleeping out under pine trees and stars
7. Watching a colorful bullfight in Spain
8. Going on a safari in Africa to hunt lions
9. Orbiting the Earth in a spaceship
10. Skiing down a high slope in the Alps
11. Climbing to the top of a high rugged mountain
12. Riding the rapids in a swift moving stream
13. Walking into an old deserted house at midnight
14. Driving a sports car in. the Indianapolis 500
15. Driving from a board 50 feet above the water
16. Riding a wild horse in a rodeo
17. Steering a sled down a steep hill covered with trees
18. Walking across a swinging bridge over a deep canyon
19. Swinging on a vine across a river filled with snakes
20. Camping out in a wilderness location

Internal Sensation

1. Letting myself go in fantasy before I go to sleep
2. Losing myself in daydreams when I am bored with what is going on
3. Letting myself experience new and unusual feelings
4. Watching a red rose turn blue before my eyes
5. Looking through a blue bottle and seeing people in a dark restaurant
6. Having an unusual dream in which I swam underwater for hours
7. Having a vivid dream with strange colors and sounds
8. Having a dream in which I lived in England in an old, haunted castle
9. Seeing a duck with the head of a cat
10. Having a dream in which I seemed to be flying
11. Dreaming that I was lying on the beach with the waves washing over me
12. Letting my body totally relax and what I feel
13. Feeling chills run all over my body
14. Having my feelings change from moment to moment
15. Having a strange new feeling as I awake in the morning
16. Experiencing abrupt changes in my moods
17. Experiencing my feelings intensely
18. Suddenly feeling happy for no reason at all
19. Focusing inside on the flow of my feelings
20. having a vivid and unusual daydream as I am riding along

External Cognitive

1. Finding out how a carburetor on a car works
2. Finding out the meanings of words I don’t know
3. Learning about a subject I don’t know much about
4. Learning new facts about World War II
5. Understanding how a computer works
6. Visiting a factory to see how paper is made
7. Figuring out how a light meter works
8. Seeing a glass blowing exhibition and listening to an explanation
9. Reading the World Almanac

10. Planning moves in checkers or chess
11. Discovering a difficult word in a crossword puzzle
12. Solving a problem involving numbers or figures
13. Figuring out how much it would cost to construct a building
14. Finding out how to unlock the two pieces of a wire puzzle
15. Discovering the villain in a detective story before he is revealed
16. Learning how to put a watch together
17. Putting together a complicated picture puzzle
18. Reading a book entitled *How Things Work*
19. Figuring out how many bricks it would take to construct a fireplace
20. Learning how to make pottery

Internal Cognitive

1. Thinking about why people behave the way they do
2. Knowing why politicians act the way they do
3. Trying to figure out the meaning of unusual statements
4. Thinking a lot about a new idea
5. Thinking of different ways to explain the same thing
6. Thinking about unusual events or happenings
7. Figuring out the shortest distance from one city to another
8. Analyzing my own dreams
9. Figuring out why I did something
10. Analyzing my own feelings and reactions
11. Thinking about ideas that contradict each other
12. Listening to a lecture or talk that makes me think afterwards
13. Reading books on subjects that stimulate me to think
14. Seeing movies after which I think about something differently
15. Discussing unusual ideas
16. Reading articles in the newspaper that provoke my thought
17. Thinking about why the world is in the shape it is
18. Analyzing a theory to see if it is a good one
19. Figuring out why some event happened the way it did
20. Starting off with a new idea and seeing the new ones suggested by the original one

Question regarding whether participants have been involved in the pretest

Have you ever read all the articles on the news portal in another Amazon HIT?

Yes, I have read all the articles in another Amazon HIT.

No, I haven't read all the articles in another Amazon HIT.

(Participants will get the compensation no matter which answer they selected. The question aims to filter out participants who attended the pretest in the data analysis phase.)

Demographic Information

Please answer the following informational questions about yourself.

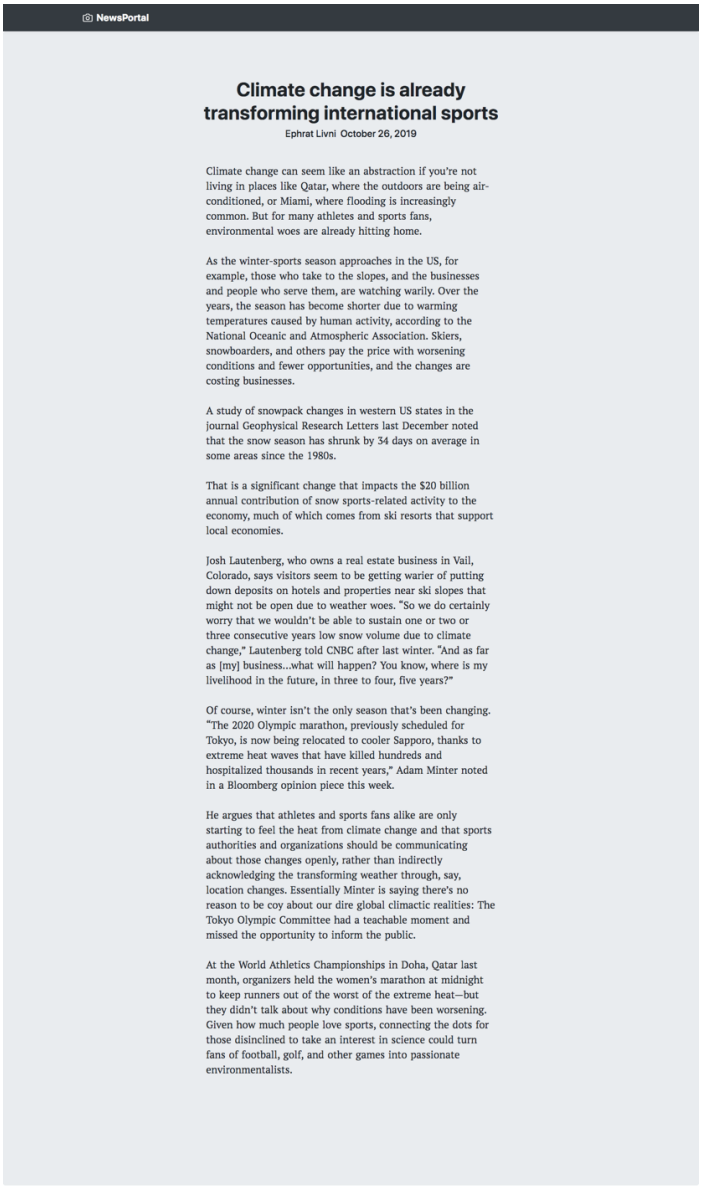
What gender do you identify yourself as?

Male

Female
Another gender identity
What the last grade or class you completed in school?
None
Grade 1-8
Grade 9-12 (High School Incomplete)
Technical, trade, or vocational school AFTER high school
College
4-year University Graduate
Post-Graduate Training
Which of the following describes your race? You can select as many as apply.
White
Black or African-American
Asian or Asian-American
Native American
Other
Attention check question (randomly placed between survey questions)
Please select the correct answer the following question.
Imagine three people, Victor, Pete, and Adam. Suppose Victor is older than Pete, and Pete is older than Adam. Who is the youngest among the three?
Victor
Pete
Adam
(If Adam is not selected, then skip to the end of the survey)

APPENDIX E:

Experimental Website Sample (Must-Read Article Page)



NewsPortal

Climate change is already transforming international sports

Ephrat Livni October 26, 2019

Climate change can seem like an abstraction if you're not living in places like Qatar, where the outdoors are being air-conditioned, or Miami, where flooding is increasingly common. But for many athletes and sports fans, environmental woes are already hitting home.

As the winter-sports season approaches in the US, for example, those who take to the slopes, and the businesses and people who serve them, are watching warily. Over the years, the season has become shorter due to warming temperatures caused by human activity, according to the National Oceanic and Atmospheric Association. Skiers, snowboarders, and others pay the price with worsening conditions and fewer opportunities, and the changes are costing businesses.

A study of snowpack changes in western US states in the journal Geophysical Research Letters last December noted that the snow season has shrunk by 34 days on average in some areas since the 1980s.

That is a significant change that impacts the $20 billion annual contribution of snow sports-related activity to the economy, much of which comes from ski resorts that support local economies.

Josh Lautenberg, who owns a real estate business in Vail, Colorado, says visitors seem to be getting warier of putting down deposits on hotels and properties near ski slopes that might not be open due to weather woes. "So we do certainly worry that we wouldn't be able to sustain one or two or three consecutive years low snow volume due to climate change," Lautenberg told CNBC after last winter. "And as far as [my] business…what will happen? You know, where is my livelihood in the future, in three to four, five years?"

Of course, winter isn't the only season that's been changing. "The 2020 Olympic marathon, previously scheduled for Tokyo, is now being relocated to cooler Sapporo, thanks to extreme heat waves that have killed hundreds and hospitalized thousands in recent years," Adam Minter noted in a Bloomberg opinion piece this week.

He argues that athletes and sports fans alike are only starting to feel the heat from climate change and that sports authorities and organizations should be communicating about those changes openly, rather than indirectly acknowledging the transforming weather through, say, location changes. Essentially Minter is saying there's no reason to be coy about our dire global climactic realities: The Tokyo Olympic Committee had a teachable moment and missed the opportunity to inform the public.

At the World Athletics Championships in Doha, Qatar last month, organizers held the women's marathon at midnight to keep runners out of the worst of the extreme heat—but they didn't talk about why conditions have been worsening. Given how much people love sports, connecting the dots for those disinclined to take an interest in science could turn fans of football, golf, and other games into passionate environmentalists.

Instruction

Please read through the headlines of the three recommended articles below and read one article that interests you by clicking on the headline of that article.

After reading the article, you will be directed to a questionnaire and answer several questions regarding your news reading experience, personality, and demographic information.

Recommended Articles

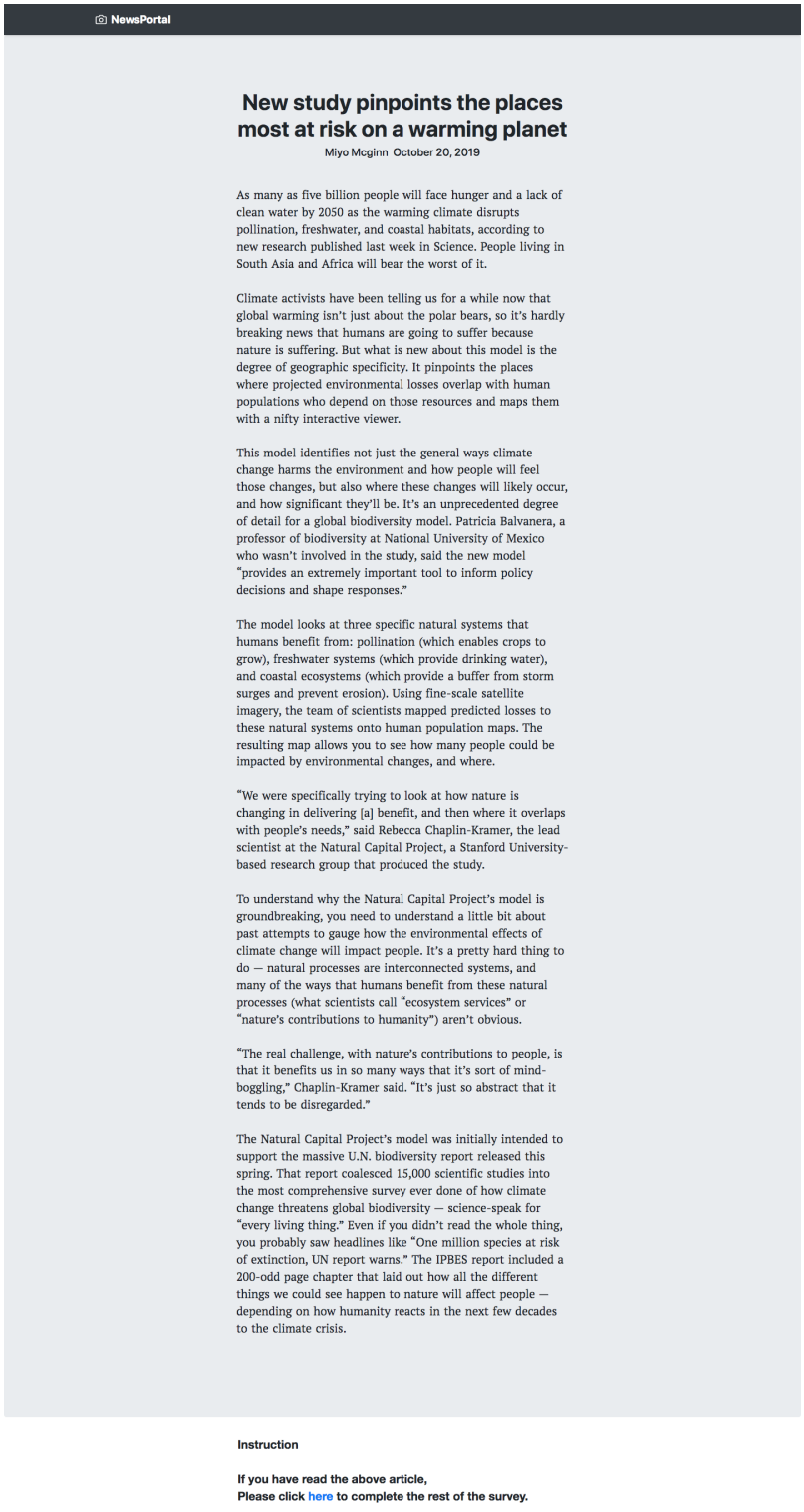
New study pinpoints the places most at risk on a warming planet

This is how climate science went mainstream

The Science of Climate Policy: Q&A with Benjamin Preston

APPENDIX E:

Experimental Website Sample (Recommended Article Page)



NewsPortal

New study pinpoints the places most at risk on a warming planet

Miyo Mcginn October 20, 2019

As many as five billion people will face hunger and a lack of clean water by 2050 as the warming climate disrupts pollination, freshwater, and coastal habitats, according to new research published last week in Science. People living in South Asia and Africa will bear the worst of it.

Climate activists have been telling us for a while now that global warming isn't just about the polar bears, so it's hardly breaking news that humans are going to suffer because nature is suffering. But what is new about this model is the degree of geographic specificity. It pinpoints the places where projected environmental losses overlap with human populations who depend on those resources and maps them with a nifty interactive viewer.

This model identifies not just the general ways climate change harms the environment and how people will feel those changes, but also where these changes will likely occur, and how significant they'll be. It's an unprecedented degree of detail for a global biodiversity model. Patricia Balvanera, a professor of biodiversity at National University of Mexico who wasn't involved in the study, said the new model "provides an extremely important tool to inform policy decisions and shape responses."

The model looks at three specific natural systems that humans benefit from: pollination (which enables crops to grow), freshwater systems (which provide drinking water), and coastal ecosystems (which provide a buffer from storm surges and prevent erosion). Using fine-scale satellite imagery, the team of scientists mapped predicted losses to these natural systems onto human population maps. The resulting map allows you to see how many people could be impacted by environmental changes, and where.

"We were specifically trying to look at how nature is changing in delivering [a] benefit, and then where it overlaps with people's needs," said Rebecca Chaplin-Kramer, the lead scientist at the Natural Capital Project, a Stanford University-based research group that produced the study.

To understand why the Natural Capital Project's model is groundbreaking, you need to understand a little bit about past attempts to gauge how the environmental effects of climate change will impact people. It's a pretty hard thing to do — natural processes are interconnected systems, and many of the ways that humans benefit from these natural processes (what scientists call "ecosystem services" or "nature's contributions to humanity") aren't obvious.

"The real challenge, with nature's contributions to people, is that it benefits us in so many ways that it's sort of mind-boggling," Chaplin-Kramer said. "It's just so abstract that it tends to be disregarded."

The Natural Capital Project's model was initially intended to support the massive U.N. biodiversity report released this spring. That report coalesced 15,000 scientific studies into the most comprehensive survey ever done of how climate change threatens global biodiversity — science-speak for "every living thing." Even if you didn't read the whole thing, you probably saw headlines like "One million species at risk of extinction, UN report warns." The IPBES report included a 200-odd page chapter that laid out how all the different things we could see happen to nature will affect people — depending on how humanity reacts in the next few decades to the climate crisis.

Instruction

If you have read the above article,
Please click here to complete the rest of the survey.

APPENDIX F:

Experimental Materials

Topic 1: Climate Change
(First article that everyone will read.)

Climate change is already transforming international sports

Ephrat Livni October 26, 2019

Climate change can seem like an abstraction if you're not living in places like Qatar, where the outdoors are being air-conditioned, or Miami, where flooding is increasingly common. But for many athletes and sports fans, environmental woes are already hitting home.

As the winter-sports season approaches in the US, for example, those who take to the slopes, and the businesses and people who serve them, are watching warily. Over the years, the season has become shorter due to warming temperatures caused by human activity, according to the National Oceanic and Atmospheric Association. Skiers, snowboarders, and others pay the price with worsening conditions and fewer opportunities, and the changes are costing businesses.

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Of course, winter isn't the only season that's been changing. "The 2020 Olympic marathon, previously scheduled for Tokyo, is now being relocated to cooler Sapporo, thanks to extreme heat waves that have killed hundreds and hospitalized thousands in recent years," Adam Minter noted in a Bloomberg opinion piece this week.

He argues that athletes and sports fans alike are only starting to feel the heat from climate change and that sports authorities and organizations should be communicating about those changes openly, rather than indirectly acknowledging the transforming weather through, say, location changes. Essentially Minter is saying there's no reason to be coy about our dire global climactic realities: The Tokyo Olympic Committee had a teachable moment and missed the opportunity to inform the public.

At the World Athletics Championships in Doha, Qatar last month, organizers held the women's marathon at midnight to keep runners out of the worst of the extreme heat—but they didn't talk about why conditions have been worsening. Given how much people love sports, connecting the dots for those disinclined to take an interest in science could turn fans of football, golf, and other games into passionate environmentalists.

Experimental Group 1(articles from Quartz website)
G1T1A1

What climate change will do to three major American cities by 2100

Allegra Kirkland, Jeremy Deaton, Molly Taft, Mina Lee & Josh Landis October 18, 2019

Climate change is already here. It's not something that can simply be ignored by cable news or dismissed by sitting US senators in a Twitter joke. Nor is it a fantastical scenario like The Day After Tomorrow or 2012 that starts with a single crack in the Arctic ice shelf or earthquake tearing through Los Angeles, and results, a few weeks or years later, in the end of life on Earth as we know it.

Instead, we are seeing its creeping effects now—with hurricanes like Maria and Harvey that caused hundreds of deaths and billions of dollars in economic damage; with the Mississippi River and its tributaries overflowing their banks this spring, leaving huge swaths of the Midwestern plains under water. Climate change is, at this very moment, taking a real toll on wildlife, ecosystems, economies, and human beings, particularly in the global south, which experts expect will be hit first and hardest. We know from the increasingly apocalyptic warnings being issued by the United Nations that it will only get worse.

But these early omens of our unstable, hot, wet future can be difficult to wrap our heads around. So Teen Vogue partnered with the team at the nonprofit news service Nexus Media, who developed a timeline predicting how climate change could affect three major US cities over the course of the 21st century. Climate change will look different in different places across the world, but we chose three places with distinct geographic concerns and climate vulnerabilities—to ground all the ominous statistics and headlines in a real sense of place. These are cities you may have visited, or where you may have family, or where you may even live.

According to the research Nexus compiled, St. Louis will see flooding, extreme heat, severe rainfall, and drought in the surrounding farmland. In Houston, on the Gulf of Mexico, hurricanes will grow more destructive and temperatures will soar. San Francisco will witness rising sea levels, fierce wildfires, and extreme drought.

This timeline is based on interviews with a dozen climate experts and a review of several dozen scientific studies. The projections assume an average sea level rise of six feet by 2100—a little more in some places, and less in others—and the business-as-usual emissions scenario, which assumes that we will continue to pollute and use fossil fuels at our current rate.

Rather than a scientific assessment, it is a rigorously researched prediction of what our future could bring unless we come together as a country and as a global community—fast—to address climate change as the crisis it is.

As Katharine Hayhoe, a climate scientist at Texas Tech University, put it: "The future is not set in stone. Some amount of change is inevitable. It's as if we've been smoking a pack of cigarettes a day for decades, but we don't have lung cancer yet."

"The amount of change that we're going to see—whether it's serious, whether it's dangerous, whether it's devastating, whether it's civilization-threatening—the amount of change we're going to see is up to us," she continued. "It depends on our choices today and in the next few years."

G1T1A2

It's official: Climate change fueled Europe's sweltering heat wave in July

Zoë Schlanger August 2, 2019

At this point, we know enough about climate change to know that, on average, it's making high-heat days more common and more extreme. But "attribution science," or the science of pinning specific weather events to climate change, is getting better all the time. It's an impactful way to internalize the effect of human-driven climate change on these extreme events—like last week's record-breaking heat wave.

During the last week of July this year, Europe positively roasted. Several people died due to excessive heat. France broke its heat records by an unheard-of three degrees Celsius in places, and Belgium and the Netherlands hit temperatures above 104 degrees Fahrenheit (40 degrees C) for the first time in recorded history. Parts of Greenland were on fire.

Thanks to rapidly-improving attribution science, we know exactly what drove that heat wave. An attribution study (pdf) published Friday (Aug 2) by meteorologists and climatologists at the UK Met Office, Oxford University, and several other European institutions found that across all European locations they looked at, the heat wave "would have been 1.5 to 3 ºC cooler" if it were not for the climate change that has taken place since the industrial revolution.

The extreme heat in France and the Netherlands was made at least 10 times—and possibly more than 100 times—more likely by climate change.

"Over France and the Netherlands, such temperatures would have had extremely little chance to occur without human influence on climate," the authors of the report wrote.

In the UK and Germany, climate change made the likelihood of a heat wave of that magnitude at least three times higher, and possibly more than 10 times higher.

The speed of study itself—published just a week after the event it is analyzing—is a testament to how much attribution science has progressed. In 2016, an attribution study that looked at how torrential rains that led to deadly flooding in Louisiana were worsened by climate change came out "less than a month" after the rains themselves, which was considered remarkably fast at the time.

Overall, July 2019 was around 1.2°C warmer than the average temperatures in July during the pre-industrial era, according to World Meteorological Organization data.

"If we do not take action on climate change now, these extreme weather events are just the tip of the iceberg. And, indeed, the iceberg is also rapidly melting," United Nations Secretary-General António Guterres said in a statement released along with the data. "Preventing irreversible climate disruption is the race of our lives, and for our lives. It is a race that we can and must win."

G1T1A4

Humans are "boiling frogs," slowly getting used to climate-change temperatures

Olivia Goldhill February 25, 2019

In the unscientific but compelling fable, a frog that's dropped in a pot of boiling water will immediately hop out, but one who's left in a pot of slowly warming water will stay there, allowing itself to be cooked. (Several myth-busting experiments have shown that a live frog will actually try to escape water as it gets warm, whereas a frog thrown in boiling water will be too hot to escape.) The allegory applies perfectly to humans' reaction to climate change, according to a study published Feb. 25 in the Proceedings of the National Academy of Sciences.

Researchers, led by Frances Moore, professor of environmental science and policy at University of California-Davis, analyzed 2 billion tweets published between March 2014 and November 2016, to determine when people turn to Twitter to talk about the weather. Unsurprisingly, they found that there are far more weather-related tweets during unusual conditions, such as an exceptionally hot day in March or one in September that's far colder than normal. But, they found that there was significantly less Twitter chatter when historically unusual weather conditions repeated within a few years. If a country experiences exceptionally cold weather for more than five years in a row, these conditions were no longer considered remarkable. And, overall, people's perceptions of normal weather are based on by experiences from the past two to eight years.

This clearly raises concerns for our perceptions of climate change. Last year was the world's fourth hottest year on record; 2017 was the most expensive year for US weather disasters in history and the third hottest year on record in the US; and in 2018 the world's oceans reached the hottest ever temperatures in recorded history. If we adjust to these new extreme heats, and start to experience them as normal, then we're less likely to recognize and confront the impact of climate change on the planet.

The UC Davis research shows that, while we may normalize unusual weather, we don't get used to its impact. The authors used measured the relative numbers of positive and negative words tweeted during times of historically unusual weather. Though people tweeted less about the weather when they repeatedly experienced extreme temperatures, the researchers found that people still tweeted more negative sentiments during particularly hot or cold periods.

"Temperature anomalies continue to have negative effects on sentiment even after 5–10 y[ears] of continuous exposure, long after those anomalies have become unremarkable," they wrote in the paper.

"We saw that extreme temperatures still make people miserable, but they stop talking about it," Moore said in a statement. "This is a true boiling-frog effect." Climate change is only going to worsen, meaning that we'll be exposed to more and more extreme temperatures. Maybe we just won't notice the heat until, like the frog, we're fully cooked.

Experimental Group 2 (retrieved from Twitter, with the hashtag #climatechange and any of the following words: business, science, culture or economy)
G2T1A1
New study pinpoints the places most at risk on a warming planet
Miyo Mcginn October 20, 2019
As many as five billion people will face hunger and a lack of clean water by 2050 as the warming climate disrupts pollination, freshwater, and coastal habitats, according to new research published last week in Science. People living in South Asia and Africa will bear the worst of it.
Climate activists have been telling us for a while now that global warming isn't just about the polar bears, so it's hardly breaking news that humans are going to suffer because nature is suffering. But what is new about this model is the degree of geographic specificity. It pinpoints the places where projected environmental losses overlap with human populations who depend on those resources and maps them with a nifty interactive viewer.
This model identifies not just the general ways climate change harms the environment and how people will feel those changes, but also where these changes will likely occur, and how significant they'll be. It's an unprecedented degree of detail for a global biodiversity model.
Patricia Balvanera, a professor of biodiversity at National University of Mexico who wasn't involved in the study, said the new model "provides an extremely important tool to inform policy decisions and shape responses."
The model looks at three specific natural systems that humans benefit from: pollination (which enables crops to grow), freshwater systems (which provide drinking water), and coastal ecosystems (which provide a buffer from storm surges and prevent erosion). Using fine-scale satellite imagery, the team of scientists mapped predicted losses to these natural systems onto human population maps. The resulting map allows you to see how many people could be impacted by environmental changes, and where.
"We were specifically trying to look at how nature is changing in delivering [a] benefit, and then where it overlaps with people's needs," said Rebecca Chaplin-Kramer, the lead scientist at the Natural Capital Project, a Stanford University-based research group that produced the study.
To understand why the Natural Capital Project's model is groundbreaking, you need to understand a little bit about past attempts to gauge how the environmental effects of climate change will impact people. It's a pretty hard thing to do — natural processes are interconnected systems, and many of the ways that humans benefit from these natural processes (what scientists call "ecosystem services" or "nature's contributions to humanity") aren't obvious.
"The real challenge, with nature's contributions to people, is that it benefits us in so many ways that it's sort of mind-boggling," Chaplin-Kramer said. "It's just so abstract that it tends to be disregarded."
The Natural Capital Project's model was initially intended to support the massive U.N. biodiversity report released this spring. That report coalesced 15,000 scientific studies into the most comprehensive survey ever done of how climate change threatens global biodiversity — science-speak for "every living thing." Even if you didn't read the whole thing, you probably saw headlines like "One million species at risk of extinction, UN report warns." The IPBES report included a 200-odd page chapter that laid out how all the different things we could see happen to nature will affect people — depending on how humanity reacts in the next few decades to the climate crisis.

G2T1A2

This is how climate science went mainstream

Katharine Rooney October 25, 2019

Environmentalism has become mainstream. Recycling is now a $200 billion global industry. Sustainability has become a significant focus for global corporations. And governments have been introducing major programmes to cut carbon emissions.

It wasn't always this way. In the 1960s, worrying about our impact on the Earth was perceived as a niche pursuit. So how did we get to where we are today? Here's a timeline of some key developments.

1962 – Silent Spring

The book that is widely seen as having launched the modern environmental movement was written by an American ecologist, Rachel Carson. Silent Springtook aim at the use of pesticides and the damage they were causing to biodiversity. Carson called for environmental stewardship and a more considered approach to human intervention in the natural world.

1989 – Margaret Thatcher

Known as "The Iron Lady" for the certainty she had about her political views, the former UK Prime Minister also raised awareness about climate change in a series of domestic and international speeches.

In November 1989, she told the UN General Assembly: "The environmental challenge that confronts the whole world demands an equivalent response from the whole world. Every country will be affected and no one can opt out."

Since Thatcher's heyday, a significant number of people around the world have come to believe that human activity is responsible for climate change – including 71% in India and 69% in Spain.

1992 - Adoption of the 'Rio Conventions'

The Rio Earth Summit in 1992 saw three conventions adopted, including the United Nations Framework Convention on Climate Change (UNFCCC), the first global treaty on the climate. The UNFCCC entered into force in 1994, with 197 countries having ratified it to date. It not only recognised the problem, but also sought to stablise emissions, direct financial support to where it was needed and keep tabs on the extent of the issue - all without impacting economic progress. The two other conventions adopted in Rio were the UN Convention on Biological Diversity and the Convention to Combat Diversification.

1997 – The Kyoto Protocol

Five years after Rio, the international community went one step further with the Kyoto Protocol, which set out binding emissions targets for developed countries. It committed 37 industrialized nations and the European Community to cut their emissions of six greenhouse gases by an average of 5% by 2012, compared with 1990 levels.

The agreement came into effect in 2005. By 2015, the countries that had taken on targets under the treaty had reduced their emissions by roughly 20%.

2015 – The Paris Agreement

The Conference of the Parties (COP) is the decision-making body of the UNFCCC. It has held a climate change conference in a different location each year since it was established in 1995.

At COP21 in Paris in 2015, parties to the UNFCCC agreed to accelerate their climate action, with the aim of keeping the global temperature rise in the 21st century well below 2°C above pre-industrial levels, and ideally limiting any increase to 1.5°C.

The Paris Agreement has now been ratified by 187 signatories. The United States was one of the first nations to sign, but the country has since announced it will withdraw from the agreement.

G2T1A3

The Science of Climate Policy: Q&A with Benjamin Preston

Rand October 22,2019

Q: Are there any common misperceptions you observe about climate change?

A: There are a number of them. The classic one is, How much can we attribute climate change to human activity? “The climate varies naturally over time, and it could be we're just in another cycle of climate variability.” We've been able to attribute the changes we see to human activity for several decades now. So the fact that we continue to argue over whether it's due to human activity or not … that drives me nuts.

At the same time, I really hate when we talk about the science “being settled.” I understand where that comes from. But the truth is, there's still much that we need to learn about how the climate system responds to human emissions and greenhouse gases.

Q: You coauthored a 2019 Center for Climate and Energy Solutions report on how we might decarbonize the U.S. economy by 2050. How feasible is that?

A: We were interested in looking at different pathways we can take to get there, and what roles different actors or parts of society could play. We walked away with two important insights. First, we need lots of technological change and innovation. We look around and say, “Oh, we have renewable energy! Look at the electric cars.” But we're going to need more innovation, technologies that aren't available now.

Second, regardless of which actors take the lead, at some point you really need everyone working together. Let's say it starts with the federal government. That can only get you so far. It's going to require action by cities, by states. It's going to require action by the private sector and by civil society. People say, “Oh, we just need a carbon tax.” That can be the impetus for a lot of downstream action. But you're not going to get there if individual consumers and the private sector aren't on board.

Q: You've also written about the need to triage climate change. What did you mean?

A: We can't protect everything from climate change—we can't protect every coastal community, we can't protect every species. So where are we going to draw a line in the sand and say, “We will protect this but not that”? We're not having that conversation at all.

Some things can't be saved; others are probably going to be fine no matter what. So you focus your energy on that middle ground where, if we don't do something, we're going to see a bad outcome; but if we do do something, we can actually make a difference.

Q: What should individual communities be doing right now?

A: They really have to start thinking long-term. This is what we practice in the research we do with communities. In some sense, this is just basic city and regional planning. But you can't just look out over the next five to ten years. With large infrastructure projects, with deciding where to develop houses, we really need to bring that long-term climate perspective into our decisions, so that whatever we plan now is still robust three or four decades into the future, when we're dealing with a different climate.

GMOs
Must-read Article
Even major food companies hate the new US rules for GMO food labeling
Chase Purdy Dec 21, 2018
Two bottles of soybean oil sit on a grocery store shelf. Both contain genetically modified (GM) soybeans from the same crop. One bottle is labelled as a GM product, the other is not.
Both are in compliance with the US Department of Agriculture's (USDA) new GM food labeling rules.
Confused? You're not alone.
Policymakers at the USDA built a massive loophole into its new rule that blatantly benefits major agricultural interests. The rule exempts certain products that typically come from genetically modified crops—including highly refined sugars, oils, and starches—from GM status. That means the soybeans and sugar beets that wind up in many of the packaged goods in grocery stores aren't considered by the government to make a food genetically modified, and thus won't have to be labeled as such.
The loophole is so glaring that even a handful of the world's biggest food companies were taken aback. Danone, Mars, Nestlé, and Unilever released a comment this week through their trade group, the Sustainable Food Policy Alliance, voicing concern that the USDA rule didn't go far enough. "The standards fall short of consumer expectations, and the practices of leading food companies, particularly when it comes to how we are already disclosing highly-refined ingredients and the threshold for disclosure," the group said in its statement.
The Environmental Working Group has estimated that about one-sixth of the foods produced with GM crops won't have to be disclosed under the new regulation. To be sure, there is no documentation that genetically modified foods have adverse health effects in humans, but despite the science, the demands of the anti-GMO movement have grown over the last several years—enough to cause big food companies to adopt less opaque food labeling policies on their own.
Based on the long-awaited rules, by January 2022, when companies do have to disclose GM food information, they'll be able to do it one of four ways:
It can be clearly written in text on the product's nutrition information panel.
It can include the USDA's new symbol for "bioengineered food."
It can be hidden behind a QR code that consumers will have to scan with their smartphones (if they have one). This method, touted by the once-powerful but now-hobbled food industry trade group, the Grocery Manufacturers Association, has been described as discriminatory toward the elderly and those unable to afford smartphones.
The package can include a text message disclosure route, such as "Text [word] to [phone number] for bioengineered food information."
Those are just a few reasons why you might get two GM soybean oil bottles that are labelled entirely differently.
The GM rules released by the USDA are also odd for another reason: the agency doesn't even use the term "genetically modified." Instead, the government is introducing a new term that's unfamiliar to the general public. "Bioengineered food" is the wording that will be required by the government.
"Much education of consumers will be needed before consumers will understand the newly disclosed information," said the Center for Science in the Public Interest in a statement.

Experimental Group 1
G1T2A1

The USDA says Crispr-edited foods are just as safe as ones bred the old-fashioned way

Katherine Ellen Foley April 2, 2018

Last week the United States Department of Agriculture (USDA) announced that it would no longer regulate crops that have been genetically edited.

Gene editing, which includes Crispr techniques, enables researchers and now farmers, to genetically nip and tuck the DNA of living things and sell them to consumers. This could mean editing to make plants bigger, more weather-resistant, or juicier.

The USDA's decision only applies to crops that have had some genes taken out, or which have had genes that are endemic to the species added to them. This editing, the regulatory agency says, is essentially a fancy form of accelerated selective breeding, and with high upside. "Genome editing…can introduce new plant traits more quickly and precisely, potentially saving years or even decades in bringing needed new varieties to farmers," the press release states. Transgenic crops, which are modified to include DNA from other species like bacteria or insects to make them pest-resistant, for example, will still be closely monitored by the regulatory agency.

Researchers have already made headway with various genetic editing techniques in the lab. There are companies and labs that have made (paywall) more efficiently growing tomato plants, non-browning mushrooms and potatoes, soy with more fatty acids, and wheat with higher fiber. Outside of edible crops, labs have also made corn that produces more of a waxy byproduct for use in making glues.

The USDA has never been particularly stringent when it comes to genetically edited foods—the group has been greenlighting these products for years, without making an official statement. That said, this recent announcement makes room for small biotech companies to develop new food products. Without having to worry about the possibility of a long, expensive regulatory process, companies working to make one or a small handful of genetically modified crops will theoretically be able to compete with massive biotech companies, like Monsanto.

DuPont Pioneer and the Broad Institute of MIT and Harvard have already enabled competition in the market by agreeing in October 2017 to provide equal licensing opportunities for certain aspects of Crispr technology to all biotech companies working in the field.

The decision to leave these foods unregulated may not be final. The US Food and Drug Administration may establish its own guidelines regarding the human health risk of genetically modified crops, a spokesperson from the agency told Wired. So far, there is no evidence that these foods pose any kind of threat to consumers.

The USDA also has yet to release a decision about whether companies will have to disclose if foods the sell have been gene-edited. This decision is currently under review in the Office of Management and Budget, and is expected to be released in July.

G1T2A2

Campbell's soup changed tomatoes' DNA and opened up a can of mystery

Ephrat Livni May 6, 2019

Genetic editing could theoretically help farmers grow the most delicious food. Using CRISPR technology, which allows scientists to cut and paste desired or unwanted traits, researchers could design ideal crops—great-tasting, nutritious, aesthetically beautiful, and better than anything previously known.

To do that, scientists need a better understanding of genetics. For all of the modern advances, genes remain something of a mystery. Experiments with selective breeding don't always yield expected results, as a new study in Nature Plants shows. Researchers from Cold Spring Harbor Laboratory in New York just solved a decades-long mystery surrounding tomato plant mutations. They call it "a cautionary tale for crop gene editing."

The perfect tomato to eat is red, plump, juicy, and bursting with flavor. When mass-produced, tomatoes also have to be easy to remove from the vine. That is why the Campbell Soup Company cultivated a variety with a genetic mutation more than a half century ago.

The one prized by Campbell is "jointless," with no bend in the stem from the vine to the tomato. In the 1960s, the company's growers noticed that a natural mutation in some plants yielded fruits that separated from the vine right where the green cap and stem touch. With the nubby stubs detached, the fruit was less likely to bruise and puncture in transit, making the jointless mutated tomatoes ideal for large-scale production. Growers, eager for convenience, soon introduced the jointless mutation, known as j2, into all kinds of tomato varieties.

There was a catch

The new plants branched and flowered much more than before, and importantly, yielded less fruit. The mutation didn't function quite like the growers had hoped. It's taken scientists and cultivators decades, plus the development of new gene editing technology, to figure out just what went wrong.

The new research reveals that an ancient gene mutation—an artifact of crop domestication more than 4,000 years old—had an unexpected interaction with j2. The desired mutation didn't work as planned because there was another factor that cultivators couldn't account for, leading to what scientists call "cryptic genetic variation."

As Cold Spring Harbor genetics professor Zachary Lippman explains in a statement on the study, "On its own, the single mutation has no obvious effect on the health or the fitness or the vigor of the plant. But when another mutation happens along with it and there is a negative interaction, that's the cryptic mutation revealing itself."

Lippman argues that researchers trying to "perfect" crops must be wary, lest they assume nature will play by rules humans can discern. He warns, "If you have a particular gene that you want to use to improve a trait, for example, by gene editing, it may very well be that the outcome is not going to be what you expected."

Yet mysteries can be solved

That's not to say that gene editing crops should be avoided, however. Lippman and his colleagues found that Florida growers managed to get the jointless fruit they sought and grow high-yield plants by continually breeding their tomatoes to perfection. They ended up essentially erasing the effect of the cryptic mutation through trial and error, ultimately growing plants that were both jointless and fruitful.

G1T2A3

Scientists are creating super-healthy, gene-edited spicy tomatoes

Chase Purdy January 9, 2019

Somewhere in an alternate universe, humans are eating spicy tomatoes.

We're not though, because 19 million years ago on Earth, the juicy fruit and its spicy cousin, the chili pepper, split from their common ancestor, forever changing the trajectory of the two cultivated plants. While they still share much of the same DNA, they've taken on much different growing patterns, shapes, and taste profiles.

The split is of interest to scientists who today wonder if advances in gene-editing techniques can once again merge the two and create a food item that incorporates the ease of mass-growing tomatoes with the nutrient benefits of chili peppers. Brazilian researchers are making the case to give this work a shot in the latest issue of the journal Trends in Plant Science. The idea isn't to create a new foodie fad, though. The point, they argue (pdf), is to get more people eating capsaicinoids, the molecules that give red peppers their spicy pizzazz, for their health benefits. Scientists say there are 23 different types of capsaicinoids, and many of those molecules have demonstrated anti-inflammatory, antioxidant, and weight-loss properties. Certain of the molecules have also been shown to ward off the development of tumors.

The problem is that it's difficult to commercially mass produce capsaicinoids. Pungent varieties of the pepper plant, also known as the genus Capsicum, are generally grown in open-field settings, which makes them more vulnerable to environmental conditions that wind up being bad for higher yields. Their sensitivity to high air temperatures, carbon-dioxide concentration, and precipitation make pepper plants an especially labor-intensive crop. And it's hard for farmers to keep their spicy Capsicum levels consistent across an entire crop.

Tomatoes, on the other hand, are very easy to mass produce because they are less sensitive to environmental factors and are also often grown indoors rather than in an open-field setting. This makes them a prime potential vehicle for engineering to contain more capsaicinoids.

As Brazilian scientist Agustin Zsögön, co-author of the opinion piece, told The Guardian, "all the genes to produce capsaicinoids exist in the tomato, they are just not active." But thanks to the gene-editing tool called Crispr, scientists think they can switch those genes back on. That'll give tomatoes the extra oomph they need to deliver even more health benefits to everyday eaters—just with a little extra spice a lot more beneficial qualities.

This isn't the only work researchers are using Crispr technology for to explore ways to enhance tomatoes. At least three groups of plant scientists around the world are currently tinkering with the genetics of tomatoes to make them better-suited to the needs of growers and shippers, as well as to enhance their flavors for the people who actually eat the fruit.

The researchers behind the journal article have already started work on their new tomato and expect to present more on their findings by the end of 2019.

Experimental Group 2 (Twitter)
G2T2A1

African scientists say GMOs could help solve plastic pollution problem

Joseph Opoku Gakpo Dec. 10, 2018

African scientists are calling for investments in the application of biotechnology to deal with the world's plastic pollution problem.

They are concerned that Africa has not explored the potential of biotechnology to help resolve the menace of plastic pollution and say there is an urgent need for it to be pursued.

"Genetically modified organisms (GMOs) could be engineered to eat up these unwanted plastic wastes," said Dr. Nii Korley Kortei, acting head of the department of nutrition and dietetics at University of Health and Allied Sciences in Ghana. "At the Kyoto University, a bacterium, has been discovered to produce a never-seen-before enzyme that can degrade plastics in few weeks."

In a paper co-authored with Dr. Lydia Quansah of Ghana's University of Development Studies and titled "Plastic waste management in Ghana," the scientists noted: "This gene could be isolated and incorporated into fungi or bacteria of choice to salvage this menace through a comprehensive biotechnology programme. We strongly believe Ghanaian scientists can develop an antidote to this problem."

Plastic pollution remains a big problem all over the world and particularly in Africa. A lot of plastics are used to convey items from the supermarket, and much of the food packaging is not biodegradable. It's usually impossible to permanently dispose of these materials after use so they remain in the environment for a very long time, often as litter.

But Kortei argued that "genetically modified micro-organisms can be engineered to undertake the process of decomposition of these complex materials." The problem of plastic pollution is particularly dire when it comes to the ocean. According to Michael Balinga, a biodiversity conservation specialist at West Africa Biodiversity and Climate Change, more than 300 million tonnes of plastics are produced globally every year. He says out of that number, only 22 percent is recycled and more than 8.8 million tonnes of plastics get dumped into the ocean annually.

"These plastics pose threats to creatures in the sea and about 700 marine animals face extinction due to the threat posed by plastics as a result of both ingestion and entanglement," Balinga noted. "It is estimated 50 percent of sea turtles have plastics in their stomachs."

A recent report by the Ellen MacArthur Foundation for the United Nations warned that by 2050, plastic waste will outweigh fish in the world's oceans.

The plastic products sometimes remain in the systems of sea creatures that are eventually consumed by human beings, thereby introducing potentially toxic materials into their systems.

The plastics in the ocean are also negatively impacting the fishing business, destroying the nets of fisherfolks and resulting in them catching less fish and more waste anytime they go to the sea.

"The situation is alarming and is not only negatively impacting the quantity of fish we harvest but also the quality of fish we get. They are not healthy," said Nii Ayi Bli, chief fisherman at James Town in Ghana.

Using genetic engineering to deal with plastics is one of the more efficient and ecofriendly approaches. Other methods, such as burning and burying plastics, are harmful to the environment. A number of genetic engineering tools have been confirmed as having the potential to deal with the problem.

G2T2A2

Top 10 Indisputable Reasons Why GMOs are Toxic

Deborah Grovins Dec 20th, 2019

In the last decade, many independent scientists and researchers have warned the public about the growing health and environmental threat associated with genetically modified foods. Many researchers have warned the public about the health risks associated with Monsanto's popular weed killer Roundup, although FDA, Monsanto and biotech lobbyists claim that GMOs and glyphosate are pretty harmless. The World Health Organization has called for a ban on glyphosate suggesting that glyphosate is a cancer causing carcinogen and toxic to the environment and human's health.

HERE ARE THE TOP 10 REASONS WHY YOU SHOULD STOP EATING GMOS:

1. GMOs and glyphosate are linked to a wide range of chronic diseases such as cancer, infertility, gastrointestinal problems, DNA change, and autism
2. Glyphosate is spreading diseases, viruses and pathogens in the soil and has devastating effects on the health of plants, soil, and the environment as well as the wild life (neonicotinoids used for treatment of 94% of GMO corn are killing millions of bees, birds, and butterflies)
3. Even if you are not eating GMOs, Monsanto's toxins are everywhere and impossible to avoid; BT toxin has been found in the blood and urine of 93% of women and their unborn fetuses. Glyphosate is also everywhere, even in the breast milk of mother across America
4. Livestock grazing on Monsanto's GMO corn treated with glyphosate are often sick and suffer from birth defects, infections or infertility
5. Even Monsanto admits that glyphosate is TOXIC; but not toxic enough
6. The allowable limit of glyphosate in US is dangerously high compared to Europe
7. Despite the promises of biotech companies, GMOs have increased the use of chemicals
8. Every year, biotech approves new generation of GMOs resistant to even more toxic herbicides such as isoxaflutole (IFT) or Agent Orange
9. GMOs are subsidized with your tax dollars and the scientific community who question the safety of GMOs and Roundup have been attacked and discredited by biotech companies
10. Despite the demands of 90% of the Americans, the US government, members of congress, and biotech companies are refusing to label GMOs

This is the scariest of them all! Why FDA and biotech companies are refusing to label GMOs? They are hiding GMOs despite the demand of 90% of the American public that want GMOs labeled. The companies have to disclose the material used on our toilet padding seats, so why not label GMOs and call it 'proudly made with GMOs'. Why the biotech is spending millions of dollars to kill GMO labeling efforts since they don't think there is anything wrong with their products? Why not let people choose freely whether or not they want to eat GMOs? Isn't this a free country and shouldn't people have freedom of choose if they don't want to eat GMOs? Before leaving the White House, Obama who promised to label GMOs passed the dark act that would undermine states mandatory GMO labeling and victories that were achieved in Vermont and Connecticut. The dark act signed by President Obama does exempt the biotech companies from labeling GMOs forever.

G2T2A4

Yes, Food Is Grown in Sewage Waste. That's a Problem.

Darlene Schanfald Dec. 23, 2019

The EPA and states must insist municipalities investigate alternative methods for reuse of sewage wastes. You may not realize it but some foods you eat may have been grown in soil containing toxic sewage wastes. Labeling is not required.

In 2019, about 60 percent of sewage sludge from 16,000 wastewater processing facilities in more than 160 U.S. cities has been spread on our soils — farmland and gardens, as well as schoolyards and lawns.

The U.S. Environmental Protect Agency (EPA) allows this use of sewage waste, claiming it has beneficial use because it contains properties similar to fertilizer — certain heavy metals, phosphorus and nitrates — that could enhance soil conditions.

The agency does not require testing for other chemicals in the sewage waste. Yet, millions of tons of sewage are processed annually and the waste can contain upward of 90,000 chemicals plus an array of pathogens, including mixtures of lead, mercury, arsenic, thallium, PCBs, PFAS, highly complex, superbugs, mutagens, pesticides, microplastics, radioactive wastes, pharmaceuticals, personal care products, steroids, flame retardants, dioxins, and/or their combinations.

Sewage treatment plants separate the processed sewage into solids and liquids (effluent), where these pollutants and pathogens concentrate.

The toxics-containing solids are often mixed with garden waste and sold for compost or recycled as fertilizers. These are spread on soils at farms, forests or recreational sites and can run off with stormwater into surface water bodies.

Currently the U.S. recycles 587 million gallons of this toxic effluent water each day for irrigation on agricultural land.

Florida, for instance, produces an estimated 340,000 dry tons of sewage solids annually, two-thirds of which are spread on land. California, arguably with the most sewage, "reclaims" at least 13 percent of its effluent; 31 percent is used for crop irrigation.

Long term damage from spreading sewage waste on land has led to many problems. For example, a variety of crops—including leafy greens and soybeans—used for food and animal fodder are known to have taken up sewage contaminants. The consequences? Contaminated food, loss of farmland and animals. Human illnesses and deaths have resulted from breathing the particulates.

Water, pollution and plastics

The EPA is currently writing a national plan for the use of sewage effluent, which they will call "recycled," "reclaimed," and "purified."

Effluent from sewage plants that is not "recycled" or "reclaimed" travels from pipes into nearby open water bodies. This not only contaminates aquatic waters and ecosystems, but the excess nitrogen can cause algae blooms and eutrophication, stealing needed oxygen from marine plants and animals.

Just this month, the Florida Senate Committee on Community Affairs recognized this threat by passing the Clean Waterways Act, CS/SB 712, "for all the reasons algae keeps blooming and fish keep dying." The bill tightens restrictions on sewage spills and sewage solids by moving septage to sewer systems and offering local governments a 50 percent matching grant to do this. The Act also regulates and ensures future septic tanks are designed, installed, operated and maintained to

prevent nitrogen and phosphorus nutrient pollution, and also ensures that sewage solids are only applied to land high enough and dry enough to prevent interaction with groundwater.