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Generation Z and CRISPR: Using the Theory of Planned Behavior to Study Voting Intention

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Abstract

This study investigated Generation Z's (Gen Z) voting intentions regarding CRISPR-related regulation, utilizing the theory of planned behavior as the framework. Understanding the perceptions of CRISPR technology in this demographic is vital as Gen Z increasingly influences consumer behavior and policy decisions. A survey was conducted with first-year Gen Z college students, gathering data on attitudes, subjective norms, perceived behavioral control, and voting intentions after exposure to an infographic displaying CRISPR-related information. Results indicated a moderately positive attitude toward CRISPR technology, with participants expressing minimal social pressure from peers but a strong sense of control over their voting decisions. These findings underscore the importance of effective communication strategies tailored to Gen Z, highlighting the need for transparency and proactive engagement to foster acceptance of CRISPR innovations in agriculture. As CRISPR technology continues to evolve, agricultural communicators and policymakers must consider these insights to navigate the regulatory landscape and promote informed public discourse.

Introduction

The introduction of clusters of regularly interspaced short palindromic repeats (CRISPR) and associated protein 9 (Cas9) technology has heralded a new era in agricultural science, promising unprecedented advancements in crop improvement and sustainable farming practices (Rasheed et al., 2021). As a powerful gene-editing tool, CRISPR technology allows researchers to more easily alter DNA sequences and modify gene function in both plants and animals (Meyer & Dastgheib-Vinarov, 2021). Advances in CRISPR technology have generated excitement as a pivotal innovation in agriculture (Mir et al., 2022), particularly as 2022 marked the 10th anniversary of its development and became the first year CRISPR-modified foods appeared on grocery store shelves (Karavolias, 2022). Notable products, such as high-oleic acid soybeans and a leafy green salad mix, highlight the potential of CRISPR technology to enhance food offerings and meet consumer preferences (Brown, 2023; Business Wire, 2019, as cited in Bicknell, 2023). As CRISPR-modified foods become more common in the marketplace, the evolving regulatory landscape will play a crucial role in determining how this technology will shape agriculture's future (Entine et al., 2021). While CRISPR technology can hold the promise of making farming more

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environmentally sustainable, improving resilience to disease, and addressing food security challenges, it also raises concerns regarding biodiversity, regulatory challenges, and the ethical implications of altering the genetic makeup of organisms (Wenham, 2023). Given these challenges, proactive stakeholder engagement is essential for navigating the complexities CRISPR technology introduces and ensuring these issues are addressed in an informed manner (Scheufele et al., 2020). The high decision stakes involved make it crucial to foster informed public discussions, as sporadic efforts may be insufficient to address the complexities of CRISPR technology (Scheufele et al., 2020).

While CRISPR technology poses a monumental scientific opportunity for the global agricultural industry, it also introduces significant legal and regulatory challenges (Haskell, 2020). Executive Order 13874, issued in 2019, emphasized modernizing the regulatory framework for agricultural biotechnology products, including those developed through CRISPR technology, by focusing on scientific evidence and risk-based approaches (United States Department of Agriculture [USDA], 2019; Bicknell, 2023). This order set a precedent for how CRISPR-modified organisms may be regulated and encouraged trade in agricultural biotechnology products based on science (Bicknell, 2023). In response, the USDA's Animal and Plant Health Inspection Service revised its regulations through the Sustainable, Ecological, Consistent, Uniform, Responsible, Efficient Rule in 2020, shifting regulatory focus to the characteristics of genetically engineered plants rather than their production methods. This approach allows for different regulatory scrutiny for CRISPR-modified crops compared to traditional genetic modification techniques (Bicknell, 2023). Moreover, Executive Order 14081, issued in 2022, aims to improve the regulatory landscape for biotechnology by promoting coordination among federal agencies and encouraging innovation in areas like food security and agriculture, which creates an environment conducive to the advancement of CRISPR technology applications (Bicknell, 2023; The White House, 2023). Recently, the United States Food and Drug Administration (FDA) released the *Guidance for Industry: Foods Derived from Plants Produced Using Genome Editing*, which clarifies regulatory expectations for foods developed using genome editing techniques, further shaping the legal landscape for CRISPR technology applications (FDA, 2024). Additionally, the United States Environmental Protection Agency (EPA) announced changes to regulations regarding genetically engineered plant-incorporated protectants in 2023, indicating a willingness to adapt regulatory frameworks as biotechnology evolves (Bicknell, 2023; EPA, 2023;). This flexibility is essential for accommodating innovations from CRISPR technology and other advanced genetic engineering techniques.

The terms "genetically modified organism" (GMO), "genetically engineered" (GE), and "genetically modified" (GM) refer to varieties of crops developed through means other than traditional breeding. Although GE is the terminology used by the FDA, the terms GMO and GM food are better aligned with the public perception (Napier et al., 2004; Ruth, 2018, as cited in Martinez et al., 2021). Despite the promise of GE, research indicates significant public skepticism toward GM foods. According to Funk and Rainie (2015), over half of Americans believe GM foods are unsafe to eat, even though 88% of scientists from the American Association for the Advancement of Science affirm their safety. Many consumers express reluctance to purchase GM-labeled foods, leading to calls for federal labeling requirements (Lang, 2013). This gap between public perception and scientific consensus underscores the necessity for proactive communication regarding emerging technologies like CRISPR. As the debate about GM food intensifies, it becomes increasingly clear that policies regarding GM technologies encompass scientific, legal, and social dimensions. The multidimensional nature of GM technologies, coupled with opposing views, suggests regulatory authorities should actively communicate how emerging GM technologies and their associated products may be regulated (National Academies of Sciences, Engineering, and Medicine, 2016).

GM foods occupy a contentious space in environmental policy, where public opinion often diverges significantly from scientific consensus, particularly among individuals aged 18 to 29 (Diamond et al., 2020; Funk & Rainie, 2015). Generation Z (Gen Z), defined as those born between 1997 and 2012, represents a growing demographic of consumers and voters who influence potential regulations and acceptance of CRISPR technology in food production. Gen Z accounts for approximately 20% of the United States population (Feger, 2024) and 40% of consumers, wielding an estimated buying power of $360 billion (Feger, 2024; Giblin, 2019). Furthermore, Gen Z is actively shaping policy decisions; 55% of registered voters aged 18 to 29 reported casting a ballot in the 2020 presidential election, the highest turnout recorded in the modern political era (Hess, 2020). In the 2022 midterm elections, Tufts University (2023) estimated that 27% of Gen Z voters participated, marking the second-highest youth voter turnout in nearly three decades, with turnout even higher in certain battleground states. In Georgia, voters aged 18 to 29 contributed to 21% of all ballots cast, representing the highest share of any state (Tufts University, 2020). According to a Pew Research Center (2020) study conducted over a year before the COVID-19 pandemic, Gen Zers notably indicated being progressive and pro-government, with seven in 10 expressing the belief that the government should take more initiative in addressing societal issues, reflecting the highest percentage among any age group surveyed. Although Gen Z currently constitutes a smaller share of the overall electorate compared to older generations, this number is expected to grow as more individuals reach voting age each year. Furthermore, Gen Z is likely the generation most receptive to societal change (Pew Research Center, 2020), making it essential to understand their attitudes toward emerging food and science technologies.

Understanding Gen Z's information consumption reveals they are true digital natives who have grown up in an internet-connected world (Institute of Business Management, 2017). This generation predominantly relies on social media for news and product discovery, with 71% turning to social media for news daily and 91% weekly (The Media Insight Project, 2022). Gen Zers surpass Millennials in daily online activity, with 35% indicating they spend over four hours a day on social media (Thomas, 2024). Research has found that nearly three-quarters (73%) of Gen Zers actively use Instagram, with 65% checking the platform daily (Institute of Business Management, 2017). The International Council of Shopping Centers (2023) found that 85% of Gen Z shoppers said social media influences their purchasing choices, with 45% identifying Instagram as the top platform influencing their purchasing decisions. Given this significant engagement with social media, particularly Instagram, it becomes imperative to explore effective communication strategies that resonate with this audience. One such strategy is the use of infographics, which can effectively convey complex information and enhance understanding of critical topics like CRISPR technology.

Both static and animated infographics are compatible with Instagram and can convey complex scientific information to a variety of audiences (Holt et al., 2020; Otten et al., 2015). Recent marketing efforts aim to build stronger relationships between food producers and consumers, utilizing engaging visuals such as infographics to enhance understanding of complex scientific topics (Burnett et al., 2019; Kelleher & Wagener, 2011; Rizvanović et al., 2023). Infographics, which use graphic design techniques to present information clearly and attractively, are an increasingly popular communication tool capable of reaching a wide audience (Afify, 2018). A study conducted by Li et al. (2018) found that when viewers were presented with complex scientific information, they relied on heuristic cues, such as design quality and source attribution, to judge the credibility of the visualized data. Additionally, when used in agricultural messaging, infographics have been shown to increase cognitive interaction and positively influence attitudes (Burnett et al., 2019). Lamm et al. (2020) sought to understand how consumers' trust in science, personal attitudes toward GM science, and perceived attitudes of others toward GM science would be affected by viewing either a static or animated infographic. The findings revealed that the animated group had the highest mean in trust in science, emphasizing the importance of further examining the role infographics play in communicating about agricultural science. These findings underscore the crucial role infographics can play in helping Gen Z make informed decisions about food biotechnology, making Instagram graphics a valuable tool in this study.

As Congress continues to consider policy issues surrounding GE, understanding and addressing public perceptions and acceptance of CRISPR technology in the United States is crucial. The largest potential pitfall for widespread use of CRISPR technology in agriculture lies in public acceptance and regulatory frameworks (Gao, 2018). Given Gen Z's substantial influence as both consumers and voters, their attitudes toward emerging food and agricultural technologies will likely shape the future of CRISPR technology in the United States (Feger, 2024; Giblin, 2019). In this research, we aimed to measure Gen Zs' attitudes, subjective norms, perceived behavioral control (PBC) regarding CRISPR technology in general, as well as their voting intentions related to CRISPR-related regulation, after being presented with information about the technology.

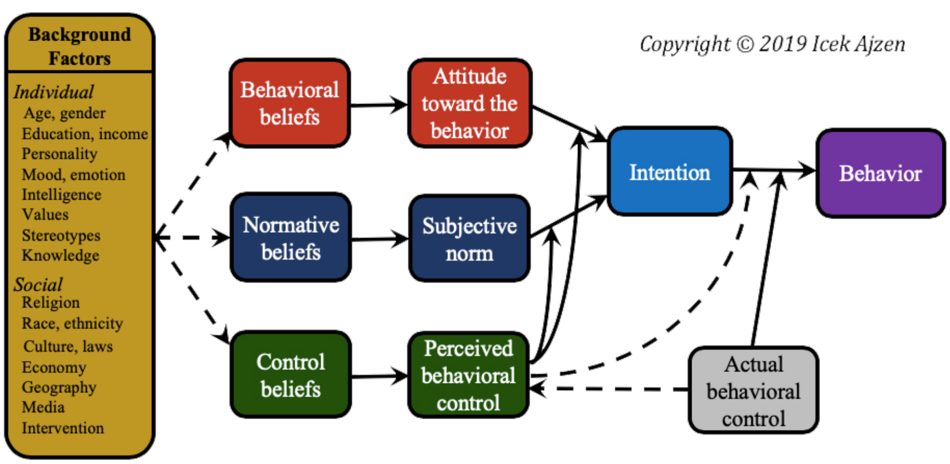
Theoretical Framework

Recognizing Gen Z's substantial influence as consumers and voters, agricultural communicators must carefully craft their messaging (Giblin, 2019; Hess, 2020). This involves addressing Gen Z's perceptions of science and technology, such as CRISPR technology, while considering their views on regulatory policies related to food and agriculture. In this study, we used the theory of planned behavior (TPB) as our theoretical framework, as it presents a model for understanding and predicting human behavior and actions (Ajzen, 1991).

At the core of the TPB is the concept of behavior change, which explains how behavioral intentions are shaped by attitudes, beliefs, and subjective norms (Ajzen, 1991). According to the TPB, three critical determinants influence the intention to perform a particular behavior: attitude toward the behavior, subjective norms, and PBC (see Figure 1). Attitude refers to a person's valuation of the behavior; subjective norms pertain to a person's assessment of social pressure from significant others regarding the behaviors; and PBC is the individual's assessment of the ease or difficulty of performing the behavior (Ajzen, 1991).

Figure 1

Theory of Planned Behavior Background Factors by Ajzen (n.d.).



While attitudes and behaviors are closely interrelated, they are not directly equivalent. Thus, the model posits that attitudes, subjective norms, and PBC collectively inform intentions (Ajzen, 1998; Spence & Townsend, 2006). Intention emerges as the strongest predictor of an individual's likelihood to change their behavior (Ajzen, 1991). Moreover, attitudes, subjective norms, and PBC can be assessed both indirectly—through corresponding beliefs—and directly—by employing scaled survey items (Hansen & Jensen, 2007).

While exceptions exist, behavioral intent has consistently been shown as a significant predictor of actual voting behavior (Hansen & Jansen, 2007). Although the TPB has yet to be explicitly applied to consumers within the domain of food biotechnology and voting intentions, it has been effectively employed in contexts related to health behaviors and GM food-related behavioral intentions (Spence & Townsend, 2006). Empirical studies have established that both attitudes and PBC are significant predictors of intentions regarding GM food purchases (Spence & Townsend, 2006). For example, Cook et al. (2002) conducted a study in New Zealand that investigated intentions to try GM food, while Saba and Vassallo (2002) explored intentions related to GM tomatoes in Italy. Both studies corroborated the predictive validity of the TPB variables. Furthermore, Antonopoulou et al. (2009) illustrated that political perceptions significantly influence consumer attitudes toward GM food, underscoring the model's relevance to understanding food-related decision-making processes.

Beyond the three core determinants, the TPB acknowledges the potential impact of other contextual variables. These background factors may encompass demographic characteristics, such as age, gender, race, religion, education, and income, as well as social characteristics, including personality traits, general attitudes, life values, and media consumption (Ajzen, 2016). The TPB framework accommodates these diverse factors to test their influence on intentions and behaviors indirectly, as they may affect one or more of the primary TPB predictors (Ajzen, 2016). This model emphasizes that background factors can explain possible precursors of behavioral, normative, and control beliefs—information that the TPB itself cannot provide (Ajzen, 2020). Additionally, the TPB framework can facilitate examinations of the mechanisms through which specific background factors influence, or fail to influence, behavior (Ajzen, 2020).

By addressing information specifically tailored to a particular generation and understanding its implications can lead to predictable shifts in food approval among other demographic groups (Brosig & Bavorova, 2019). Therefore, leveraging the TPB to investigate Gen Z's perceptions of CRISPR technology and to forecast regulatory voting intentions is vital for informing agricultural communication strategies surrounding this pertinent topic and its associated policies.

Purpose and Objectives

The purpose of this study was to identify the determinants of voting intentions for Gen Z regarding CRISPR-related regulations after exposure to a CRISPR-related communication message. We used the following research objectives to guide the study:

RO1: Describe respondents' attitudes, subjective norms, and perceived behavioral control regarding CRISPR technology in general, and their voting intentions specifically toward CRISPR-related regulations.

RO2: Determine whether respondents' attitudes, subjective norms, and perceived behavioral control regarding CRISPR technology in general predicted their voting intentions toward CRISPR-related regulations.

Methods

To address the proposed research objectives posed above, we distributed an online survey-based instrument via Qualtrics to assess Gen Z's attitudes, subjective norms and PBC regarding CRISPR technology in general, and voting intentions regarding CRISPR-related regulations. The data in this study are part of a larger research effort aimed at identifying effective visual communication strategies related to CRISPR technology (see Martinez et al., 2021).

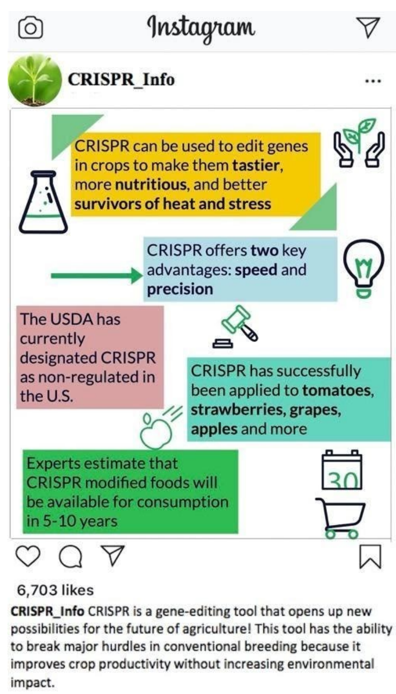
A total of 488 responses were collected, resulting in a preliminary response rate of 20.3%. However, our final sample included 158 usable responses. Useable responses were deemed acceptable for respondents who matched the Gen Z characteristics for age. Additionally, respondents who did not meet our quality checks (i.e., failed attention checks or incomplete responses) were eliminated from our sample. Based on the number of respondents who started the study and the number of respondents who were kept for the final sample, the completion rate for our study was 32.37%.

Instrument Development

To effectively communicate pertinent information about CRISPR technology in relation to food and agriculture, we developed an infographic (see Figure 2) as an intervention. Infographics are known for their ability to draw attention and contextualize data, making them a valuable tool for engaging audiences (Afify, 2018, as cited in Lamm et al., 2020). We chose to present the CRISPR technology information via Instagram, the most used social media platform among Gen Z voters for receiving information on contemporary topics. Bright colors and concise messaging were intentionally selected to capture participants' attention and enhance their understanding of CRISPR's implications, as previous research indicates that social media significantly influences Gen Z's perceptions and decision-making processes (Turner, 2019). While the information presented in the infographic was accurate at the time of its use in March 2021, we recognize this as a limitation due to the rapid advancements in CRISPR technology, which may result in the content becoming outdated. Nevertheless, exploring the potential of infographics as a tool for conveying scientific information to Gen Z voters remains highly relevant. By presenting complex topics in a visually appealing format, the infographic may contribute to enhancing understanding and awareness of CRISPR technology.

Figure 2

Infographic Treatment



Data were collected through a series of questions constructed using Ajzen's (2006) *Constructing a Theory of Planned Behavior Questionnaire* to gather relevant information for forming the TPB variable scales. To ensure both face and content validity of the survey instrument, we enlisted a panel of experts to review it for content accuracy, clarity of wording, readability, and overall survey design. This expert panel comprised a Professor of Science Communication and two Associate Professors of Agricultural Communication from the University of Georgia, all of whom have expertise in visual communication, science communication, and public opinion research. Prior to launching the survey, we conducted a pilot test with a similar but separate sample to assess the reliability of the adapted and developed scale items (Dillman et al., 2014). All scale items demonstrated reliability (α = .70 or higher), allowing us to proceed with the data collection process (Dillman et al., 2014; Wimmer & Dominick, 2014).

Data Collection Procedure and Variables

To complete the questionnaire, the respondents were first asked to agree to the University of Georgia approved IRB consent form. After, they were asked to view the infographic treatment. A timer was set to ensure each respondent spent a minimum of 30 seconds viewing the infographic. After the viewing period, respondents answered a comprehension question about the infographic as an attention filter. Following the infographic treatment, respondents answered questions that measured their attitudes, subjective norms and PBC toward CRISPR technology in general and voting intentions concerning CRISPR-related regulations. Following, they answered other questions regarding their demographics. Finally, respondents were thanked for their time.

TPB Variables

The questions related to attitudes, subjective norms, and PBC were primarily focused on the respondents' perceptions and beliefs about CRISPR-modified products, while the voting intention questions specifically targeted their likelihood of voting on related regulations. This distinction was necessary to align the measures with the different constructs they were assessing.

Attitudes. We assessed attitudes using a five-point Likert-type scale, with respondents indicating their level of agreement or disagreement with the following five statements: "I believe food produced using CRISPR is nutritious," "I believe CRISPR food is advantageous to the agricultural industry," "I believe using CRISPR is safe for the environment," "I believe CRISPR foods are safe to eat," and "I would purchase food produced using CRISPR" (1 = Strongly Disagree; 2 = Disagree; 3 = Neither Agree nor Disagree; 4 = Agree; 5 = Strongly Agree). A mean score from these five statements was calculated to represent overall attitude, with reliability assessed *ex post facto* (α = .84). The real limits of the scale were 1–1.49 = Strongly Disagree, 1.50–2.49 = Disagree, 2.50–3.49 = Neither Agree nor Disagree, 3.50–4.49 = Agree, 4.50–5 = Strongly Agree.

Subjective Norms. We measured subjective norms by having respondents indicated their level of agreement or disagreement with six statements using the same five-point Likert-type scale. The statements included: "Those who are important to me would approve if I ate CRISPR-produced food," "I feel there would be social pressure from my family to avoid eating CRISPR-produced food," "Those who are important to me would mind if I ate CRISPR-produced food," "I feel social pressure to share my family's views on CRISPR even if they differ from my own," "I belong to an organization that would hinder my belief that CRISPR is beneficial," and "I hold political views that would hinder my belief that CRISPR is beneficial." A mean score from the responses to these six statements was calculated to represent overall subjective norm, with reliability assessed *ex post facto* (α = .77). The real limits of the scale were 1–1.49 = Strongly Disagree, 1.50–2.49 = Disagree, 2.50–3.49 = Neither Agree nor Disagree, 3.50–4.49 = Agree, 4.50–5 = Strongly Agree.

PBC. We measured respondents' PBC by asking them to indicate their level of agreement or disagreement with five statements using a five-point *Likert-type scale*. The statements included: "I have control over whether or not I support CRISPR," "Political leaders do not influence how I feel about CRISPR," "I could eat CRISPR-produced food even if my family does not," "I am able to obtain adequate information about CRISPR," and "If I want to, I can avoid eating CRISPR-produced food." A mean score from the responses to these five statements was calculated to represent overall PBC, with reliability assessed *ex post facto* (α = .76). The real limits of the scale were 1–1.49 = Strongly Disagree, 1.50–2.49 = Disagree, 2.50–3.49 = Neither Agree nor Disagree, 3.50–4.49 = Agree, 4.50–5 = Strongly Agree.

Voting Intention. We measured voting intention by asking respondents to answer the following five questions: "I will vote for favorable regulations that advance CRISPR technology," "If CRISPR were on the ballot in the next election, I would vote in favor of its use," "I will be sure to vote if CRISPR is on the ballot," "I will vote along my political party views regardless of whether the party shares my views on CRISPR regulations," and "I will contact my state representative and ask them to advance favorable CRISPR regulations." Respondents indicated their level of likelihood or unlikelihood using a five-point Likert-type scale (1 = Not likely at all; 2 = Unlikely; 3 = Neither unlikely nor likely; 4 = Likely; 5 = Very likely). A mean score from the responses to these five statements was calculated to represent overall voting intention, with reliability assessed *ex post facto* (α = .72). The real limits of the scale were 1–1.49 = Strongly Disagree, 1.50–2.49 = Disagree, 2.50–3.49 = Neither Agree nor Disagree, 3.50–4.49 = Agree, 4.50–5 = Strongly Agree.

The data were analyzed using SPSS 26.0. A multiple regression analysis was conducted to determine the relationship between the TPB variables (attitude, subjective norms, and PBC) and voting intention toward CRISPR-related regulations.

Results

Respondents' Attitudes, Subjective Norms, Perceived Behavioral Control, and Intentions

In the first research objective, we examined the variables of the TPB—attitude, subjective norms, and PBC—in relation to the voting intention of CRISPR-related regulations. Detailed means and standard deviations of the TPB model components are provided in Table 1.

Table 1

Means and Standard Deviations of TPB Model Variables (N = 158)

Variable	*M*	*SD*
Attitude	3.50	0.66
Subjective norms	2.50	0.68
Perceived behavioral control	3.90	0.68
Intention	3.10	0.72

Note. Scales were five-point Likert scales, where 1 indicates negativity toward behavior and 5 indicates favor toward behavior (for all variables apart from subjective norms, for which 1 indicates a low level of social pressure and 5 indicates a high level of social pressure).

We found that the attitude scale measured respondents' attitudes toward CRISPR and purchasing behaviors, revealing a grand mean of 3.50 (*SD* = 0.66), indicating respondents generally agreed with positive statements about CRISPR technology. The subjective norms scale assessed social pressure from organizations and significant others, with a grand mean of 2.50 (*SD* = 0.68). This score suggests that, on average, respondents neither agreed nor disagreed about experiencing social pressure to adopt CRISPR technology. The PCB scale, which gauged respondents' confidence in their ability to engage with CRISPR technology, had a grand mean of 3.90 (*SD* = 0.68), indicating that respondents agreed they had sufficient confidence to perform behaviors related to CRISPR technology. Lastly, the intention scale, which measured respondents' voting intention for favorable CRISPR-related regulations, yielded a grand mean of 3.10 (*SD* = 0.72), suggesting that respondents neither agreed nor disagreed about their intent to support CRISPR-related regulation.

Predicting intent to vote with TPB variables

To determine whether respondents' attitude, subjective norms, and PBC predicted voting intention toward CRISPR-related regulation, we conducted a multiple regression analysis (see Table 2). The model was statistically significant, $F(3,154) = 29.708$, $p < .001$, and the predictors accounted for 37% of the variance in voting intention ($R^2 = .37$). Attitude ($\beta = .510, p < .000$) and subjective norms ($\beta = .165, p <$

.013) were statistically significant predictors of voting intention. In contrast, PBC ($\beta = .131$ p = .063) was not a statistically significant predictor of voting intention. The Cohen's f^2 of 0.59 indicated a large effect size.

Table 2

TPB Variables Predicting Voting Intention

Variable	β	t	p
Constant		.466	.642
Attitude	.510	7.302	.000*
Subjective norms	.165	2.516	.013*
Perceived behavioral control	.133	1.875	.063

Note. $R^2 = .37$; $F(3,154) = 29.708$, $p < .001$; Dependent Variable: Voting Intention; *$p < .01$.

Conclusions, Implications, and Recommendations

The purpose of this study was to utilize the TPB to explore how agricultural communication messaging can inform voting intentions regarding CRISPR technology among Gen Z. The findings offer insights into how Gen Z's attitudes, subjective norms, PBC shape their engagement with CRISPR technology, emphasizing the need for strategic communication approaches tailored to this generation.

Our first research objective aimed to describe respondents' attitudes, subjective norms, PBC, and voting intentions toward CRISPR-related regulations. The results indicated respondents had a neutral intent to vote for favorable CRISPR-related regulations, as their scores fell within the "Neither agree nor disagree" range. Additionally, participants demonstrated a generally positive attitude toward CRISPR technology, as indicated by scores within the "Agree" range, minimal social pressure from valued others with scores in the "Neither agree nor disagree" range, and relatively strong PBC, reflected by scores in the "Agree" range regarding their ability to vote favorably on CRISPR-related regulation. These findings suggest Gen Z consumers may be inclined to embrace CRISPR technology, which aligns with previous research indicating Gen Z is the most open generation to societal change (Pew Research Center, 2020).

Our second research objective assessed whether respondents' attitudes, subjective norms, and PBC predicted voting intention toward CRISPR-related regulation. The results indicated that the TPB variables accounted for 37% of the variance associated with intention to vote for CRISPR-related regulations. Attitude accounted for the largest portion of the variance, corroborating findings from other studies that have consistently identified attitudes as significant predictors of intentions toward GM foods (Cook et al., 2002; Saba & Vassallo, 2002; Sparks et al., 1995). This trend may indicate a shift in public perceptions toward a more positive outlook among younger consumers. Our findings indicate a need for further investigation in the areas of communication strategies, consumer perceptions, and the role of governance related to CRISPR technology in food and agriculture.

A limitation of our study was that the relationship between intention and behavior could not be measured, as CRISPR-modified food products were not yet available on the market during the study period, and there were no biotechnology policies on the ballot for voters to consider in 2020 or 2022. However, according to Ajzen (1991), once a voter has developed their voting intention, their commitment to that intention is typically strong. Supporting this, Watters (1989) found voting behavior in the 1988 election was highly consistent with individuals' voting intentions. Therefore, we infer that the Gen Z respondents in our study would likely support regulatory policies that promote CRISPR technology rather than hinder it. When conducting research in communication using the TPB, it is essential researchers consider how individuals align themselves within society and how they wish to be perceived when predicting intentions

(Holt et al., 2020). Future research employing the TPB should include a larger and more representative sample of Gen Z respondents to investigate voting intention. Such findings would enhance understanding of Gen Z's influence as consumers and voters.

Additionally, our study's findings may be influenced by the communication strategy employed, specifically the use of an infographic to present CRISPR technology information prior to respondents answering survey questions. Given that 65% of Gen Z receive their news from Instagram (Taylor, 2019), presenting the infographic on this platform could have enhanced participants' comprehension of the information. It is suggested that this form of visual communication may assist individuals in making more informed decisions regarding CRISPR technology. As Instagram is a visually driven platform with considerable influence over Gen Z, infographics could effectively engage audiences with agricultural messaging. Moreover, there is potential for utilizing Instagram to segment information for consumers through tailored infographics, as the platform allows for specific messaging targeted to distinct user groups. This approach is advantageous since audience segmentation can significantly enhance social marketing efforts (Ibrahim et al., 2018; Warner, 2019). When individuals within a segment share common characteristics, it leads to more effective communication and supports the diffusion of new ideas or practices (Rogers, 2003; Warner, 2019). Therefore, recognizing the potential role of infographics in shaping respondent perceptions, we recommend that future research examine the relationship between audience segmentation of infographics and public acceptance of CRISPR technology.

While this study focused on CRISPR technology in the context of food and agriculture, CRISPR technology is currently making significant positive impacts in the health science community. Examples include eliminating malaria from mosquitoes, treating Alzheimer's disease and HIV, and aiding in the development of cancer therapies (Crawford, 2017). Positive perceptions of CRISPR technology in health sciences may influence how Gen Z embrace CRISPR technology in agricultural contexts. If Gen Z views CRISPR technology favorably in health science, there could be a corresponding positive reception in agricultural production. Therefore, it can be inferred that if Gen Z is enthusiastic about the potential impacts of CRISPR technology, they are more likely to vote for favorable regulations regarding its use. Agricultural communicators and researchers should thus remain attuned to consumers' attitudes related to CRISPR technology applications in both health science and agricultural production.

In conclusion, both CRISPR-modified food products and Gen Z are poised to play pivotal roles in shaping the future of the food industry. Agricultural communicators need to share information about CRISPR technology in engaging, relatable ways that resonate with this progressive generation. By leveraging visual communication strategies, such as infographics on platforms like Instagram, stakeholders can enhance understanding and acceptance of CRISPR technology. Additionally, as CRISPR technology continues to demonstrate its potential in health sciences, the positive perceptions cultivated in that realm may extend to agricultural applications. Therefore, a comprehensive approach that integrates insights from both health and agriculture can facilitate a more informed and supportive public discourse. As we move forward, it is possible to recognize and harness the potential of Gen Z as both consumers and advocates for innovative agricultural practices, ensuring their voices contribute to the responsible advancement of CRISPR technology in the food and agriculture sector.

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