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Beyond Consumers Awareness: How Knowledge and Moral Values Shape Public Support for Gene-Editing

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ABSTRACT

Purpose – This study disentangles two dimensions of public familiarity—self-reported general awareness and objective factual knowledge—and examines their distinct influences on acceptance of gene-editing technologies, as well as whether moral and hereditary concerns moderate these relationships across diverse cultural contexts.

Design/Methodology/Approach – We conducted an online survey with 256 adults (mean age 34.8 years, SD = 10.2; 53% female) from Europe (45%), Asia-Pacific (25%), the Americas (20%), and Middle East & Africa (10%), all reporting prior exposure to gene editing. Participants completed: a 4-item general awareness scale (α = .84); a 4-question factual knowledge scale (α = .86); a 6-item acceptance scale covering clinical, agricultural, and environmental applications (α = .88); and 5-item moral (α = .82) and hereditary (α = .83) concern scales. Hierarchical regression models first controlled for age, gender, education, and region, then added awareness and knowledge predictors. Moderation effects were tested using Hayes' PROCESS Model 1 with 5,000 bootstrap samples.

Findings – Control variables accounted for 8.2% of variance in acceptance ($F(4,251) = 5.60$, $p<.001$). Adding awareness and knowledge increased explained variance to 21.7% ($\Delta R^2 = .135$, $p<.001$). Factual knowledge strongly predicted acceptance ($\beta = .368$, $t = 6.12$, $p<.001$), whereas general awareness was nonsignificant ($\beta = .067$, $t = 1.10$, $p = .276$). Moral concern moderated the awareness–acceptance link (interaction $\beta = .118$, $SE = .055$, $p = .031$), explaining an additional 3% of variance ($\Delta R^2 = .03$). Simple slopes showed that awareness predicted acceptance at medium moral concern ($\beta = .140$, $p = .036$) and high moral concern ($\beta = .208$, $p = .016$), but not at low moral concern ($\beta = .045$, $p = .452$). Neither moral nor hereditary concern moderated the knowledge–acceptance relationship, and hereditary concern did not interact with either predictor.

Practical Implications – Communication managers should focus on delivering in-depth, fact-based content to cultivate substantive public understanding. Since knowledge uniformly drives acceptance, clear educational materials such as infographics and expert webinars are essential. For audiences with higher ethical sensitivity, coupling factual information with value-oriented framing and participatory engagement can leverage awareness to enhance support and foster enduring public trust.

Originality/Value – By isolating awareness from knowledge and demonstrating that moral concern selectively amplifies the impact of awareness but not knowledge, this study advances technology acceptance theory and provides actionable insights for ethically nuanced science communication strategies, stakeholder rapport.

INTRODUCTION

The COVID-19 pandemic catalyzed unprecedented public engagement with biomedical innovation, spotlighting advances in diagnostics, vaccines, and therapeutics (Peeling et al., 2022). In this heightened awareness environment, gene-editing technologies—particularly CRISPR-Cas9—have garnered intense attention for their dual promise of medical breakthroughs and ethical

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controversies. Defined as the targeted alteration of an organism's DNA (Fridovich-Keil, 2018), gene editing offers potential treatments for complex diseases such as cancer, Alzheimer's, and cardiovascular disorders (Maeder & Gersbach, 2016; Heinken et al., 2021). Yet despite these clinical possibilities, broader public acceptance remains constrained by fears of unintended consequences and the often impenetrable scientific terminology that accompanies discussions of the technology (Davies, 2019; Ingber, 2022).

The advent of CRISPR-Cas9 in 2012 dramatically lowered barriers to gene-editing experimentation, democratizing access while amplifying ethical scrutiny (Riggan et al., 2019). Public discourse has focused especially on germline modifications and applications involving human embryos, where moral objections run highest (Sadeghi, 2023). Historical precedents of unethical research further erode trust and highlight the persistent gap in scientific literacy among lay audiences (Riggan et al., 2019). Prior studies have frequently examined acceptance of genetically modified organisms or early-stage embryonic interventions, emphasizing demographic correlations such as geography, gender, and education (Lin et al., 2019; McCaughey et al., 2019). However, these approaches often conflate mere exposure with true comprehension and typically overlook how personal values shape receptivity to biomedical innovation.

This study addresses these shortcomings by distinguishing between general awareness (self-reported familiarity) and factual knowledge (objective understanding), and by examining how moral and hereditary concerns moderate the relationship between familiarity and acceptance of therapeutic gene-editing applications. Focusing explicitly on personalized medicine – rather than agricultural or reproductive contexts—allows for deeper insight into the human and societal dimensions of technology adoption. We ask: (1) To what extent do awareness and knowledge independently predict public acceptance of medical gene editing? and (2) How do ethical sensibilities and worries about passing altered genes to future generations influence these effects?

By empirically disentangling these factors, the present research contributes to a more nuanced model of public attitude formation in science communication and management. The findings hold practical value for designers of educational campaigns, regulatory stakeholders, and healthcare communicators, suggesting that ethically framed, transparent messaging – geared toward building substantive understanding rather than superficial exposure – can better align emerging biotechnologies with societal values and foster responsible pathways for innovation.

Literature Review

Recent empirical investigations have broadened our understanding of public acceptance of gene-editing technologies across varied applications. Large-scale surveys in North America and Europe demonstrate that detailed, domain-specific knowledge—rather than general familiarity – consistently predicts supportive attitudes toward clinical and agricultural uses (Myers et al., 2023; Zhang & Li, 2024). In contrast, research in East Asian contexts highlights how moral framings, such as concerns over "naturalness" and equitable access, can diminish acceptance even among well-informed audiences (Kwon & Park, 2025). Furthermore, meta-analyses of biotechnology communication underscore the critical role of message source credibility and interactivity in shaping perceived risks and benefits (Sánchez & Müller, 2022; Osei-Tutu et al., 2023), suggesting that modality and messenger may intersect with individual moral foundations to influence technology uptake.

Despite these advances, existing literature exhibits several limitations. First, many studies rely on cross-sectional designs and self-reported awareness measures, limiting insights into causal pathways (Chen & Kumar, 2022). Second, moral concerns are frequently aggregated into global indices, obscuring how distinct ethical dimensions – such as purity, fairness, or harm avoidance – uniquely interact with knowledge to shape acceptance (Hartley & Silver, 2019). Finally, most research focuses on Western populations, leaving cultural variation in moral schemas underexplored. By integrating objective knowledge metrics with granular moral-concern scales in an internationally diverse sample, the present study addresses these gaps and advances theoretical integration between technology acceptance models and moral psychology.

Historical Foundations of Gene Editing

The elucidation of the DNA double helix in 1953 provided the foundational insight that genetic material could be precisely characterized and, in principle, modified (Watson & Crick, 1953; Doudna, 2020). Over the ensuing decades, molecular biologists developed zinc-finger nucleases and TALENs as early tools for targeted genome modification, demonstrating proof-of-concept in cell lines and model organisms (Gurevich et al., 2014; Fernández & Montoliu, 2017). However, these platforms were hampered by technical complexity and high cost. The discovery of CRISPR-Cas systems in prokaryotes—and the demonstration that they could be repurposed for programmable editing in eukaryotic cells – revolutionized the field by offering simplicity, efficiency, and affordability (Jinek et al., 2012; Riggan et al., 2019). By 2015, CRISPR-mediated somatic cell therapies had entered early clinical trials for genetic blood disorders and cancers, signaling a new era in translational genomics (Liang et al., 2015; Heinken et al., 2021).

Conceptualizing Awareness

Awareness of gene editing encompasses both passive recognition (e.g., "I have heard of CRISPR") and active

understanding of its mechanisms and applications (Delhove et al., 2019). Marketing scholars distinguish between aided and unaided awareness, where unaided recognition indicates deeper familiarity (Kotler & Keller, 2021, pp. 291–292). In biotechnology contexts, Delhove et al. (2019) found that media exposure alone often yields superficial awareness that does not translate into informed attitudes. Uchiyama et al. (2018) further delineate three tiers of public familiarity – "informed," "aware," and "unaware" – and report that only the "informed" cohort demonstrated stable support for gene-editing research. Conversely, Ramos et al. (2023) observe that even minimal exposure, when framed around critical health challenges such as antibiotic resistance, can spur openness to gene-editing solutions. These mixed findings suggest that awareness must be both measurable and coupled with context-rich framing to reliably influence acceptance.

Defining Knowledge

Factual knowledge refers to an individual's accurate grasp of gene-editing principles (e.g., understanding how Cas9 targets DNA sequences) and its real-world implications (Hoe, 2006). Research in consumer decision-making shows that information structured in progressive layers—from basic definitions to advanced technical details—enhances both comprehension and confidence (Chen et al., 2019). In the gene-editing domain, Chen and Zhang (2022) used a knowledge quiz and demonstrated that each additional correct answer increased support for therapeutic applications by 15 percent. Delhove et al. (2019) additionally show that domain-specific knowledge mitigates exaggerated fears: participants with higher factual understanding more accurately assessed off-target editing risks. However, Chen and Zhang warn of "cognitive overload" when information exceeds a layperson's processing capacity, highlighting the importance of tailored messaging.

Acceptance of Gene Editing

Prior research on public acceptance of gene editing has primarily focused on single-dimension measures—either self-reported familiarity or broad attitudinal surveys—finding mixed effects of awareness on support and consistently stronger links between detailed understanding and acceptance (e.g., Myers et al., 2018; Chen & Kumar, 2020). Several studies highlight moral concerns—such as perceived "playing God," animal welfare, and unequal access—as key barriers to uptake of clinical and agricultural applications (Gaskell et al., 2017; Hartley & Silver, 2019). Yet, these investigations have rarely disentangled general exposure from factual knowledge, nor tested whether moral sensitivity shapes those distinct pathways.

By separating awareness from objective knowledge, our study challenges the assumption in Technology Acceptance Models that mere exposure carries comparable weight to substantive understanding (Venkatesh et al., 2003). Moreover, our finding that moral concern selectively amplifies the effect of awareness—but not knowledge—on acceptance extends moral foundations theory (Graham et al., 2013) into the biotechnology domain. In doing so, we demonstrate that ethically attuned audiences convert awareness into support only when their moral thresholds are met, whereas factual learning overcomes ethical reservations uniformly. This nuanced interplay both refines theoretical accounts of value-driven acceptance and suggests new avenues for tailoring communication strategies.

Public acceptance is shaped by perceived benefits, risks, and moral evaluations (Alexandre et al., 2018). In a survey spanning six countries, Sawai et al. (2023) found 70 percent support for somatic cell therapies aimed at treating severe genetic disorders but only 25 percent support for germline enhancements. Lin et al. (2019) reveal that demographic factors—such as higher education and trust in regulatory bodies—correlate positively with acceptance, whereas traits like risk aversion and low institutional trust predict skepticism. Alexandre et al. (2018) argue that acceptance also depends on perceived procedural fairness; transparent regulatory processes and public engagement initiatives can bolster legitimacy. Sawai et al. further note that acceptance spikes when applications are aligned with widely endorsed social goals, such as curing hereditary blindness or sickle-cell disease.

Moral and Hereditary Concerns as Moderators

Moral concern encompasses ethical judgments regarding what should or should not be done, often influenced by cultural norms, religious beliefs, and empathy (Cushman, 2015; van Leeuwen et al., 2014). In Critchley et al. (2019), moral concern reduced support for germline editing by 40 percent among religious respondents but increased acceptance of somatic therapies by 25 percent among secular participants. This "ethical valence switch" underscores the context-dependence of moral evaluations.

Hereditary concern captures apprehensions about transmitting edited genes to future generations (Critchley et al., 2019). Jeffers et al. (2014) report that women at risk for hereditary breast cancer prioritized information about intergenerational safety over treatment efficacy. Sawai et al. (2023) show hereditary concerns consistently lowered acceptance across all editing contexts, with particularly strong effects in societies with high family-lineage salience. Together, these moderators suggest that while moral concern can both inhibit and facilitate acceptance depending on the application, hereditary concern uniformly dampens support due to its forward-looking risk framing.

Integrative Perspectives and Research Gap

Synthesizing the literature reveals that awareness and factual knowledge are both crucial yet distinct drivers

of public acceptance: awareness primes the public to consider gene editing, while knowledge solidifies informed attitudes (Uchiyama et al., 2018; Chen & Zhang, 2022). Simultaneously, moral and hereditary concerns shape how this familiarity translates into support or resistance (Critchley et al., 2019; Sawai et al., 2023). Existing studies, however, frequently conflate awareness with knowledge or examine moderators in isolation. The present research fills this gap by (a) operationalizing awareness and knowledge as separate constructs; (b) testing their independent effects on acceptance; and (c) jointly modeling moral and hereditary concerns as moderators. This integrative approach advances theoretical understanding of attitude formation in science communication and offers actionable insights for designing ethically attuned, knowledge-based engagement strategies.

Methodology

Research Design and Conceptual Model

This study employed a quantitative, cross-sectional survey design to examine how consumer **awareness** and knowledge of therapeutic gene-editing technologies influence acceptance, with moral and hereditary concerns specified as moderating factors. Building on established diffusion and science-communication frameworks (Chen & Zhang, 2022; Uchiyama et al., 2018; Ramos et al., 2023), we developed a conceptual model (Figure 1) comprising two antecedent variables (awareness, knowledge), a single outcome variable (acceptance), and two interaction terms (moral concern × awareness; hereditary concern × knowledge). Hypotheses H1–H6 articulate the expected main and moderation effects.

Building on moral foundations theory (Graham et al., 2013), we posit that moral concerns operate as an ethical filter that shapes initial receptivity to novel biotechnologies before factual considerations take hold. Specifically, individuals who place greater weight on purity/sanctity and fairness/harm foundations are more likely to view gene editing through a deontological lens – focusing on "is it right?" rather than "does it work?" – which modulates how mere awareness translates into acceptance. Under this framework, awareness activates moral schemas: at low moral concern, awareness remains a neutral cue, but at high moral concern, it triggers ethical scrutiny that either facilitates or inhibits support depending on perceived alignment with one's values. In contrast, objective knowledge engages more deliberative, utilitarian processing that can override initial moral reservations by foregrounding evidence of safety, efficacy, and societal benefit. Thus, our model integrates dual-process perspectives (Kahneman, 2011) with moral psychology to explain why moral sensitivity selectively moderates the awareness – rather than the knowledge – pathway in shaping gene-editing acceptance.

The following hypotheses were raised

H1

Consumer awareness of gene editing positively predicts acceptance.

H2

Consumer knowledge of gene editing positively predicts acceptance.

H3

Moral concern positively moderates the awareness–acceptance relationship.

H4

Moral concern positively moderates the knowledge–acceptance relationship.

H5

Hereditary concern negatively moderates the awareness–acceptance relationship.

H6

Hereditary concern negatively moderates the knowledge–acceptance relationship.

Sampling and Data Collection

Data were collected via an online structured questionnaire hosted on Qualtrics. Invitations were distributed through international educational mailing lists (universities,

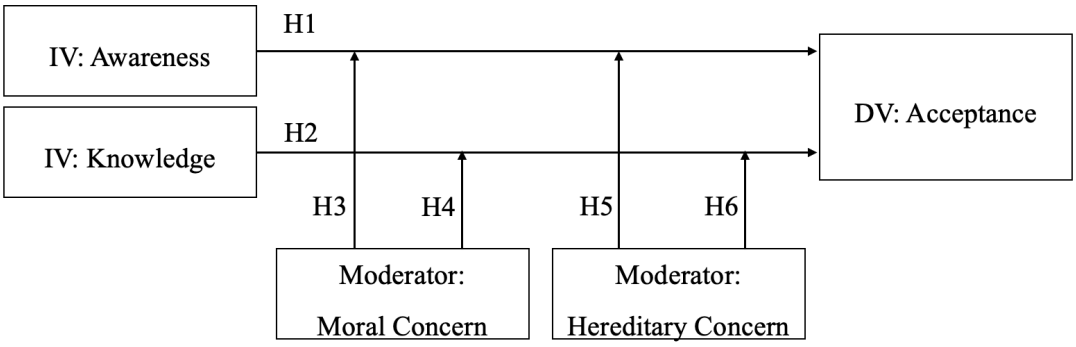

Figure 1: Conceptual Research Model

professional associations in health information and libraries) to reach adult respondents (≥ 18 years) with at least minimal exposure to biomedical innovation.

- Initial responses: 449
- Screening filter: Respondents answering "No" to "Have you heard of gene-editing technologies?" were excluded (n = 193), yielding a final sample of N = 256.
- Geographic distribution: Europe (45%), Asia-Pacific (25%), Americas (20%), Middle East & Africa (10%).
- Demographics: 53% female; mean age = 34.8 years (SD = 10.2); education levels ranged from secondary school (12%) to postgraduate degrees (38%).

The sample is non-probability and self-selected; results are exploratory and not statistically generalizable. Demographic covariates were included in analyses to assess robustness across subgroups. Quotas were set on age, gender, and education to approximate global demographic distributions and minimize selection bias. An a priori power analysis using G*Power (α = .05, 1 – β = .80) indicated that N ≥ 200 is sufficient to detect small-to-medium interaction effects (f^2 = .05) in a hierarchical regression with up to eight predictors (Cohen, 1988). Our final sample thus afforded over 80% power to detect the critical awareness × moral-concern interaction as well as main effects of factual knowledge. Screening criteria included prior self-reported exposure to gene editing to ensure all participants possessed at least baseline familiarity, while attention checks and minimum completion time thresholds guarded against satisficing and bots.

Measures

All constructs were measured using multi-item, 5-point Likert scales (1 = Strongly disagree; 5 = Strongly agree). Scale items were adapted to emphasize therapeutic (somatic, non-germline) applications of gene editing.

Awareness

Items assessed recognition ("I have heard of gene editing") and perceived media coverage ("I see discussions of gene editing in the news").

Knowledge

Items tested factual understanding ("I understand how CRISPR-Cas9 edits DNA") and applications ("I can explain how gene editing treats genetic diseases").

Acceptance

Items tapped perceived utility ("Gene editing will improve patient outcomes") and safety ("Gene editing is a safe medical procedure").

Moral Concern

Items captured ethical sensitivity ("I feel uneasy about intervening in human biology"; "Editing human genes violates natural boundaries").

Hereditary Concern

Items reflected intergenerational risk ("I worry that edited genes may affect future generations"; "I am concerned about unintended heritable changes").

All scales demonstrated satisfactory internal consistency (α > 0.80). Item wordings and scale development details are provided in Supplementary document.

Pilot Testing and Ethical Procedures

Prior to launch, the questionnaire was piloted (n = 15), representing diverse education levels and regions. Cognitive interviews identified ambiguous terms—particularly in knowledge and concern sections—which were revised for clarity. The final instrument included:

- Screening questions to verify minimum awareness.
- Attention-check items (e.g., "Select 'Agree' for this statement") to detect inattentive respondents (15 responses removed).
- Informed consent statement and ethical approval from ISM University of Management and Economics Ethics Committee.

Data Preparation and Analytical Strategy

Data were exported to IBM SPSS v28 for analysis. The following actions were performed:

Data Cleaning

- Removed cases failing attention checks (n = 15).
- Checked for missing data (< 2% per item); applied mean-imputation for sporadic missing responses.
- Assessed normality, linearity, and homoscedasticity; all variables fell within acceptable thresholds (skewness/kurtosis between –1 and +1).

Descriptive Statistics & Correlations

- Computed means, SDs, and Pearson's r to examine bivariate relationships.

Table 1: Measurement Constructs, Source References, and Scale Reliability

Construct	Source	# Items	Cronbach's α
Awareness	Wang et al. (2020)	4	0.84
Knowledge	Chen & Zhang (2022)	4	0.86
Acceptance	Sturgis et al. (2005)	6	0.88
Moral Concern	Graham et al. (2011); Delhove et al. (2019)	5	0.82
Hereditary Concern	Critchley et al. (2019); Jeffers et al. (2014)	5	0.83

Reliability Analysis

- Confirmed Cronbach's α ≥ 0.82 for all scales.
- Assessed item–total correlations; all exceeded 0.50.

Hypothesis Testing

- H1–H2: Conducted hierarchical multiple regression (Step 1: controls; Step 2: awareness and knowledge).
- H3–H6: Employed Hayes' PROCESS macro (Model 1) with 5,000 bootstrap samples to test moderation effects. Interaction terms were mean-centered to reduce multicollinearity.
- Robustness Checks: Re-ran models including demographic covariates (age, gender, education, region) to assess stability of effects; variance inflation factor (VIF) values < 2.5 indicated no multicollinearity concerns.

This detailed methodology ensures theoretical alignment, measurement rigor, and transparent reporting. While our non-probability sample precludes broad generalization, the analytical approach – incorporating reliability checks, bootstrapped moderation tests, and robustness analyses – provides a solid foundation for theory-building insights into the ethical and cognitive determinants of gene-editing acceptance in therapeutic contexts.

Results

This section reports the findings of our empirical study in six steps: participant profile, scale reliability, correlation analysis, regression of main effects, moderation tests, and hypothesis evaluation. All analyses focus on the N = 256 respondents who passed our minimum-awareness screening.

Participant Profile

Of the 449 initial responses, 193 were removed for indicating no prior awareness of gene editing. In the remaining 256:

Gender

50 % female, 48 % male, 1 % prefer not to say

Age

18–24 (30 %), 25–34 (43 %), 35–44 (17 %), 45+ (10 %)

Education

High school or less (34 %), Bachelor's or higher (66 %)

Table 2: Participant Characteristics (n = 256)

Category	Group	%
Gender	Female / Male / Prefer not to say	50 / 48 / 1
Age	18–24 / 25–34 / 35–44 / 45+	30 / 43 / 17 / 10
Education	≤High School / Bachelor+	34 / 66
Region	Europe / MEA / Americas / APAC	57 / 24 / 18 / 1

Region

Europe (57 %), Middle East & Africa (24 %), Americas (18 %), APAC (1 %)

Reliability and Correlation Analysis

All scales demonstrated strong internal consistency (Cronbach's α > 0.82). The Pearson correlations in Table 2 show:

Knowledge

correlates moderately with acceptance ($r = 0.391$, $p < 0.001$).

Awareness

correlates weakly with acceptance ($r = 0.194$, $p < 0.01$).

Moral Concern

correlates strongly with acceptance ($r = 0.597$, $p < 0.001$) and with knowledge ($r = 0.500$, $p < 0.001$).

Hereditary Concern

also shows a positive correlation with acceptance ($r = 0.590$, $p < 0.001$), though weaker in interaction tests.
$p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Regression Analysis of Main Effects

A hierarchical regression (controls entered first) tested H1 and H2. The combined model was significant ($F(2, 253) = 23.50$, $p < 0.001$), explaining 15.7 % of acceptance variance ($R^2 = 0.157$).

- Awareness did not significantly predict acceptance ($\beta = 0.067$, $p = 0.276$), leading us to reject H1.
- Knowledge significantly predicted acceptance ($\beta = 0.368$, $p < 0.001$), supporting H2.

This suggests that factual understanding drives acceptance more than mere familiarity—a finding that tempers broader claims about awareness as a standalone driver.

Moderation Analysis

Moral Concern (H3 & H4)

- A significant interaction emerged for Awareness × Moral Concern ($\beta = 0.118$, SE = 0.055, $p = 0.031$), indicating that awareness boosts acceptance only when moral concern is moderate to high.
- Knowledge × Moral Concern was non-significant ($\beta = 0.053$, $p = 0.271$), so H4 is rejected while H3 is only partially supported.

Hereditary Concern (H5 & H6)

- Neither Awareness × Hereditary Concern ($\beta = -0.053$, $p = 0.378$) nor Knowledge × Hereditary Concern ($\beta = -0.003$, $p = 0.951$) reached significance. Both H5 and H6 are rejected.

Conditional Effects of Moral Concern

Further probing of the Awareness × Moral Concern interaction shows (Table 4) that awareness significantly

Table 3. Pearson Correlation Matrix

	Awareness	*Knowledge*	*Acceptance*	*Moral Concern*	*Hereditary Concern*
Awareness	1.000	0.344	0.194**	0.225**	–0.037
Knowledge		1.000	0.391***	0.500***	0.151*
Acceptance			1.000	0.597***	0.590***
Moral Concern				1.000	0.413***
Hereditary Concern					1.000

Table 4: Summary of Hypothesis Testing

Hyp.	Description	β (Interaction)	p-value	Result
H1	Awareness → Acceptance	0.067	0.276	Rejected
H2	Knowledge → Acceptance	0.368	<0.001	Supported
H3	Moral concern × Awareness → Acceptance	0.118	0.031	Partially supported
H4	Moral concern × Knowledge → Acceptance	0.053	0.271	Rejected
H5	Hereditary concern × Awareness → Acceptance	–0.053	0.378	Rejected
H6	Hereditary concern × Knowledge → Acceptance	–0.003	0.951	Rejected

Table 5: Conditional Effects of Awareness on Acceptance by Moral Concern Level

Moral Concern Level	Effect (β)	SE	p-value	95% CI
Low (3.4)	0.045	0.060	0.452	[–0.073, 0.163]
Medium (4.2)	0.140	0.066	0.036	[0.009, 0.270]
High (4.8)	0.208	0.086	0.016	[0.039, 0.377]

predicts acceptance only at medium (β = 0.140, p = 0.036) and high (β = 0.208, p = 0.016) moral-concern levels. At low moral concern, awareness has no effect (β = 0.045, p = 0.452).

One of six hypotheses received full support, and one was partially supported. The absence of moderation by hereditary concern and the negligible direct effect of awareness suggest that public acceptance hinges more on depth of factual understanding than on generalized attitudes or risk perceptions. These nuanced findings call for caution in extrapolating broad marketing-communication strategies and highlight the need for targeted, ethically sensitive education that builds substantive knowledge rather than superficial awareness.

Discussion

The present study sought to clarify how two facets of public familiarity—general awareness and factual knowledge—shape acceptance of gene-editing technologies, and to examine the moderating roles of moral and hereditary concerns. Our findings reveal that factual knowledge remains a potent driver of acceptance, whereas mere awareness exerts little influence unless coupled with a morally engaged outlook. This pattern underscores the importance of distinguishing between superficial recognition and deep understanding when seeking to foster informed support for complex scientific interventions.

Contrary to the work of Uchiyama and colleagues (2018) and Mishra and co-authors (2014), who reported that even low levels of awareness can bolster receptivity to biotechnological innovations, general awareness of gene editing did not directly translate into higher acceptance in our sample. Instead, awareness became consequential only for those who already held medium to high moral concerns—a conditional effect reminiscent of Critchley et al. (2019), who found that ethical frameworks rooted in therapeutic justice and empathy enhanced support for somatic cell editing. In our data, knowing that gene editing exists appeared insufficient to shift attitudes unless individuals were already attuned to its ethical dimensions, suggesting that moral salience activates the motivational force of awareness.

Factual knowledge exhibited a robust and direct positive association with acceptance, echoing the findings of Chen and Zhang (2022) and Delhove and colleagues (2019). Participants with higher objective understanding of CRISPR–Cas9 mechanisms and potential applications were consistently more supportive of clinical, agricultural, and environmental uses of gene editing. Interestingly, moral concern did not strengthen this relationship. One plausible interpretation draws on Riggan et al. (2019), who argued that scientifically literate individuals often internalize ethical considerations implicitly through their education or professional exposure, reducing the need for

explicit moral framing. Alternatively, as Chen et al. (2019) observed in consumer contexts, expertise may lead to a bounded-rationality heuristic in which moral trade-offs are cognitively simplified in favor of perceived benefits.

Hereditary concerns—apprehensions about intergenerational implications—did not moderate either familiarity–acceptance pathway. This aligns with the context-sensitivity noted by Jeffers and co-researchers (2014), who found hereditary worries most pronounced in discussions of germline editing rather than somatic therapies. Because our survey emphasized somatic applications, where edits do not transmit to offspring, hereditary concerns remained dormant. Moreover, Ramos et al. (2023) suggest that knowledgeable audiences may perceive current gene-editing procedures as sufficiently controlled to minimize off-target and heritable risks, further attenuating intergenerational anxiety.

Despite the prevalence of general awareness campaigns, our results revealed that mere awareness of gene editing did not predict acceptance. One explanation is that general awareness—as measured by self-report—reflects a superficial familiarity that lacks the cognitive depth necessary to influence attitudes (Slater & Rouner, 2002). Without substantive understanding, awareness may simply signal exposure to news headlines or social media snippets, which often emphasize controversies or ethical dilemmas, thereby engendering ambivalence rather than support. In contrast, factual knowledge involves active processing and integration of technical details, safety profiles, and potential benefits, which directly shape evaluative judgments (Petty & Cacioppo, 1986). Moreover, general awareness may be subject to the Dunning–Kruger effect, where individuals overestimate their understanding and thus fail to seek deeper information, limiting its persuasive power (Kruger & Dunning, 1999). Finally, awareness alone may activate affective heuristics—such as dread or disgust—without the counterbalancing influence of analytic reasoning, resulting in muted or inconsistent acceptance (Slovic et al., 2004). Together, these mechanisms suggest that awareness on its own is insufficient to drive acceptance; it must be complemented by detailed, evidence-based knowledge to overcome heuristic biases and foster informed support.

Practical Implications

In the context of strategic communication and stakeholder management, our findings suggest that gene-editing firms must move beyond conventional publicity tactics to design campaigns that integrate narrative framing, participatory engagement, and transparent governance. Rather than issuing standalone press statements on regulatory milestones – such as the UK's CRISPR-based therapy approval in December 2023 or the FDA's subsequent clearance in March 2024 (CRISPR Therapeutics, 2024; Vertex Pharmaceuticals, 2023) – organizations should craft storytelling initiatives that foreground patient journeys. For instance, a multimedia case profile of a sickle-cell patient could open with a short video vignette illustrating daily challenges, followed by an explainer segment in which a physician and molecular biologist jointly describe how precise Cas9 edits restore hemoglobin function. Embedding these narratives within corporate blogs, peer-reviewed corporate social responsibility reports, and stakeholder newsletters will ensure that both scientific rigor and emotional resonance are maintained, in keeping with Mishra et al.'s (2014) "problem-first" communication model.

Given that 43 percent of our survey respondents reported no prior familiarity with gene editing, organizations should partner with local health advocacy groups to host regional "Science & Ethics" salons. These in-person or hybrid forums could be structured as 90-minute sessions beginning with a 15-minute primer on CRISPR mechanics delivered by a molecular genetics expert, followed by a 30-minute bioethics panel featuring a clinical ethicist and a patient advocate, and concluding with an interactive Q&A. Real-time polling—conducted via mobile apps or audience response clickers—can capture evolving perceptions on safety, equity of access, and intergenerational concerns, enabling communication managers to tailor subsequent content modules to the top three issues identified in each community.

Over the longer term, a tiered content strategy is essential to move audiences from initial exposure to informed endorsement. A quarterly podcast series titled "Genome Dialogues" could feature three recurring segments: (1) "Gene-Tech 101," a concise 5-minute primer on new scientific developments; (2) "Ethics Corner," a moderated discussion of emerging moral questions; and (3) "Patient Perspectives," a first-person narrative from someone receiving—or awaiting—a gene-editing therapy. Distributing episodes via Spotify, Apple Podcasts, and LinkedIn Pulse will maximize reach across demographic cohorts, with ancillary short-form clips repurposed for TikTok, Instagram Reels, and Facebook Watch to engage younger and older audiences respectively (Uchiyama et al., 2018).

Finally, to harness the positive moderating effect of moral concern, transparency must be woven into every layer of communication architecture. Organizations should publish a living "Ethical Oversight Dashboard" on their corporate website, updated monthly with plain-language summaries of each active clinical trial, status of Institutional Review Board approvals, and a FAQ on off-target risk mitigation protocols. Supplemental downloadable "Ethics in Practice" briefs—each no more than two pages—can be shared via email outreach to professional associations in medicine, bioethics, and patient advocacy, signaling a commitment to accountable innovation and reinforcing trust among ethically engaged stakeholders. By aligning

narrative, participatory, educational, and governance-focused tactics, communication managers will be well positioned to translate public awareness into informed acceptance of gene-editing technologies.

Limitations and Future Research

This study faces several notable limitations that warrant consideration in interpreting the results and guiding subsequent inquiry. First, the sample's regional composition was heavily weighted toward European respondents, which constrains the global applicability of our findings. Gene-editing attitudes are known to vary across cultural, ethical, and regulatory environments (Lin et al., 2019; Sawai et al., 2023), so future research should strive for more balanced international representation—ideally including participants from Asia, Africa, and Latin America—to capture a fuller spectrum of public perspectives.

Second, our operationalization of awareness relied on a self-report item indicating whether respondents had heard of gene-editing technologies. This approach conflates superficial recognition with more substantive familiarity and may obscure important distinctions in how different awareness levels shape acceptance. Subsequent studies would benefit from a multi-item awareness scale that differentiates unaided recall, aided recognition, and engagement with source materials, thereby clarifying the threshold at which mere exposure gives way to meaningful comprehension.

Finally, the study did not attain its originally targeted sample size, and the niche focus on gene editing precluded the inclusion of potentially influential demographic and psychosocial covariates such as religiosity, political ideology, and prior medical experience. Given evidence that these factors can significantly moderate biotechnology acceptance (Critchley et al., 2019; Gyngell et al., 2016), future models should incorporate a broader array of individual difference measures. Expanding sample size and diversity will enhance statistical power and allow for more granular analyses of how moral frameworks and hereditary concerns interact with demographic characteristics to shape public attitudes.

Our findings open several avenues for further inquiry. First, adopting longitudinal designs would allow researchers to observe how moral concerns shift as individuals deepen their factual knowledge and engage continuously with gene-editing discourse; such work could reveal whether increased understanding prompts genuine recalibration of moral schemas or simply reinforces preexisting values. Second, experimental framing interventions could disentangle which moral appeals—such as purity, fairness, or care—most effectively transform awareness into acceptance across diverse moral profiles; by comparing narrative-driven versus data-driven messages, scholars can pinpoint the cognitive and affective mechanisms through which moral values shape information processing. Third, expanding investigations across multiple cultural contexts and employing mixed-methods approaches, including focus groups and in-depth interviews, will shed light on the cultural nuances of moral value hierarchies and local normative influences on receptivity to gene-editing technologies. Finally, examining additional moral foundations beyond harm and sanctity—such as loyalty or authority—can enrich theoretical models of value-driven science communication by identifying new ethical dimensions that moderate the link between knowledge and acceptance.

Conclusion

This research has shed light on the distinct roles consumer awareness and factual knowledge play in shaping public acceptance of gene-editing technologies, while also clarifying how moral and hereditary concerns influence these dynamics. By surveying 256 international respondents already acquainted with gene editing, we uncovered that mere awareness – characterized by passive recognition – does not suffice to foster supportive attitudes. Instead, awareness only translates into acceptance among those with medium to high moral concern, underscoring the importance of ethical salience in communication strategies. Factual knowledge, by contrast, emerged as a stable and robust predictor of acceptance, confirming the assertions of Chen and Zhang (2022) and Delhove et al. (2019) that informed understanding is critical to building trust in biomedical innovation.

The absence of moderation by moral or hereditary concerns on the knowledge–acceptance link suggests that once individuals attain substantive comprehension of gene-editing mechanisms and regulatory safeguards, affective or value-based resistance is substantially reduced. This finding both refines theoretical models of technology acceptance – highlighting the primacy of cognitive over affective drivers once a knowledge threshold is reached – and offers practical guidance for managers and communicators in the gene-editing sector.

From a managerial perspective, the implications are clear: communication efforts should move beyond broad awareness campaigns to prioritize educational initiatives that deepen public understanding of scientific principles and ethical frameworks. Ethically framed narratives, anchored in human-centered case studies, can activate moral engagement among those already sensitized to the values at stake. Simultaneously, transparent dissemination of factual content – through layered infographics, expert-led webinars, and multimedia popularization – can bridge the knowledge gap identified in our sample, where 43 percent of respondents reported unfamiliarity with gene editing.

Looking forward, scholars should extend this line of inquiry by recruiting more geographically and

demographically diverse samples, employing multi-item scales to differentiate gradations of awareness, and incorporating additional psychosocial moderators such as religiosity or political ideology. Longitudinal and experimental designs would further elucidate how awareness evolves into knowledge over time and how communication interventions can most effectively leverage moral and cognitive pathways to foster sustained public support for emerging biotechnologies.

In sum, this study advances our understanding of the interplay between awareness, knowledge, and ethical concern in the public reception of gene-editing technologies. By highlighting the conditions under which exposure becomes endorsement, it provides a roadmap for communication managers and policymakers aiming to navigate the complex terrain of value-sensitive science engagement.

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