



# Public Attitudes and Willingness to Pay for Cultured Meat: A Cross-Sectional Experimental Study

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Previous research has suggested that the general public is divided over their willingness to consider consuming cultured meat (CM) products. As commercial backing for cultured meat startups increases and the public interest in the US, Europe, and developing countries expands, formally evaluating attitudes to these products will become increasingly important. Willingness to pay (WTP) may provide insight into the level of acceptability of CM products, highlight latent societal preferences, and suggest commercial opportunities. To date, no studies have evaluated the societal WTP for CM products. A cross-sectional internet-based survey was distributed to 300 respondents in the US general population using a survey panel design. The mean age was 30 (range: 18–76), and 47% of respondents were male. We presented respondents with a series of scenarios relating to CM products, framing CM burgers as environmentally friendly vs. as a better alternative to traditional burgers. Prior research has highlighted taste and price as areas of societal concern, but no studies have rigorously evaluated the intersection between these considerations. When CM products were framed as being equivalent in taste to conventional meat, and where their environmental benefits were stressed, respondents were willing to pay significantly more than for a traditional burger (\$2.11 vs. \$1.00). This WTP jumped to \$2.66 when framing the CM burger as the best burger, reflecting a 266% premium that consumers were willing to pay for an appropriately framed CM burger. Framing CM burgers as a *better* alternative to traditional burgers, rather than focusing on their environmental impact, similarly led to the highest desirability ratings. These preferences were also reflected in a contingent valuation discrete choice experiment examining preferences for paying \$1 for a traditional burger vs. \$2 for a CM burger. These findings support our hypothesis regarding the existence of what we term the gold-standard bias, a cognitive bias that systematically favors a product or service framed as the best available choice over and above its marginal benefit, and has significant and broad implications for feasibility, pricing, and marketing, suggesting the need for further research in this area.

**Keywords:** willingness to pay, cultured meat-based proteins, biases and heuristics, preferences, gold standard bias

## INTRODUCTION

Cultured meat (CM) has been the subject of increased interest and scrutiny over the past several years, as several commercial startups have worked aggressively to move the product from the laboratory to the factory and consumer (Post, 2012). Aside from the intense media interest sparked by CM development (Goodwin and Shoulders, 2013; Laestadius and Caldwell, 2015), the need for alternative pathways for meat production have been spurred by a complex range of market forces, including increasing global demand for meat—a function of both the rising middle class in emerging markets such as China and increased social pressures for meat consumption as a marker of wealth (conspicuous meat consumption)—as well as concerns related to the environmental impact of traditional beef production in terms of greenhouse gas emissions, land use, and water use that may possibly be ameliorated by CM (Tuomisto and Teixeira de Mattos, 2011; Mattick et al., 2015a,b). Moreover, the COVID-19 pandemic has served to further inflame concerns regarding the safety and robustness of the traditional beef marketplace and supply chain, and therefore a scalable alternative source of meat supply may be of significant interest.

There is a burgeoning literature on public attitudes to CM consumption and production; a recent systematic review highlighted 14 studies evaluating consumer attitudes using a range of techniques (Bryant and Barnett, 2018), and an update to this review included 26 additional studies (Bryant and Barnett, 2020). Few studies, however, have attempted to tease out the importance of framing CM products in developing public acceptance, despite the acknowledgment that how CM is described may have a marked impact on public responses (Bryant and Barnett, 2018), though one recent study examined whether providing information on CM impacted taste preferences (Rolland et al., 2020) and others have addressed the importance of positive framing (Bryant and Barnett, 2020). This is a key lacuna, as there is a wide behavioral economics literature that highlights the ways in which framing can affect acceptability, particularly for novel technologies. While studies consistently show that consumers are not interested in framing CM as high-technology and scientifically advanced (Bryant and Dillard, 2019), this has not yet translated into a broad shift in presentation from either the media or CM producers.

Willingness to pay, or contingent valuation, is an established methodology to establish a threshold level of societal acceptability (Meyer et al., 2018; Song and Lee, 2018). It has been used for a range of goods and services, from foodstuffs to cosmetic and surgical medical procedures (Botelho et al., 2017; Chen et al., 2019; Kantor, 2021). While it has the potential to elicit public preferences in a granular fashion, this approach has never been applied to CM products.

Given the importance of CM and the gaps in the literature surrounding both framing and WTP, we performed a WTP analysis that presented US consumers with a range of scenarios involving CM in order to elicit their WTP for CM products and explore the associations between preferences and baseline demographic variables.

## METHODS

After iterative pilot testing, we developed a cross-sectional online survey of the general US population to assess consumer attitudes to CM and determine their WTP. Ethics approval for this study was obtained from Cambridge University, Judge Business School. The survey was prepared on the Qualtrics platform (Qualtrics Corp, Provo, Utah) and distributed to a sample of the US population aged 18 and over through Prolific Academic (Oxford, United Kingdom), a platform for academic survey research (Peer et al., 2017). Prolific Academic maintains a database of >100,000 potential respondents in multiple countries categorized by age, sex, and location, and sends them an invitation to participate in a study; while there is an option to have Prolific Academic stratify respondents by age, sex, and race to achieve a representative national sample, (Kantor and Kantor, 2020a,b), we used a convenience sample of US-based respondents for this study. Given the survey panel design, no actual response rate is available, though Prolific Academic performs internal checks to establish the validity of respondents' responses. Respondents were rewarded with a small payment (<US\$1). Subjects provided consent and were allowed to terminate the survey at any time, and all responses were confidential.

Baseline responses to survey questions were recorded, and demographic information was self-reported by respondents. Responses to questions regarding WTP for CM hamburger patties were recorded using a slider scale ranging from \$0 to \$5 after anchoring subjects to a \$1 price point for a standard beef hamburger. The default position of the slider was set at \$1. Subjects were also asked regarding the perceived desirability of CM burgers, with a range of 0 (worse than a regular burger) to 100 (better than a regular burger), with 50 indicating equivalence. The slider's default position was set at 50. We also performed a discrete choice experiment (DCE) to determine what proportion of respondents would prefer to pay \$2 for a CM patty rather than \$1 for a standard patty.

In order to determine whether framing a CM burger as a better alternative to a standard hamburger patty would affect WTP, we presented respondents with two scenarios distributed in random order. In one iteration, CM burgers were framed as environmentally friendly, and in the alternate presentation they were presented as a better alternative to standard burgers.

The environmentally-friendly framing language was presented as follows: "Imagine that a company has developed a way to make hamburgers that taste, look, and smell, exactly like the usual beef hamburgers that you are used to. Instead of coming from cows, these burgers are made in a factory by growing the meat cells from cows. This means that these burgers are just like regular burgers but they have much less environmental impact (no cow grazing, no methane release) and no cows are killed to make them."

In contrast, the best-tasting framing was presented as follows: "Imagine that a company has created a way to make the best hamburgers in the world by culturing the meat cells from the world-famous Wagyu beef. These burgers can be available to everyone and taste better than anything out there. Instead of

coming from cows, these burgers are made in a factory by growing (culturing) the meat cells from cows.”

*T*-tests and chi-squared tests were used as appropriate for baseline continuous and categorical variables. Subgroup comparisons of non-normally distributed data were performed using the Kruskal Wallis test. Paired *t*-tests were used to compare responses stratified by scenario presentation. Univariate logistic regression odds ratios of association were assessed between the dependent variable of preference for paying \$2 for a CM patty over \$1 for a standard patty in the DCE and baseline characteristics. Univariate logistic regression odds ratios of association were also assessed between the dependent variable of willingness to pay at least \$1 for a CM burger (equivalent to a traditional burger) and baseline characteristics. Statistical analyses were performed using Stata 13 for Mac (College Station, Texas).

## RESULTS

Of the 311 total surveys, 6 refused consent and 5 failed to answer any questions after providing consent, yielding a total of 300 usable surveys. The mean (SD) age was 30 (11.0), and respondents were 47% male. Detailed baseline characteristics of the respondents are included in **Table 1**.

When framed as environmentally friendly, respondents were willing to pay a mean of \$2.10 [95% confidence intervals (CI) 1.97, 2.24] for a CM patty after being anchored to a \$1 reference price for a standard beef patty. When framing the CM burger as the best burger, respondents were willing to pay \$2.66 (95% CI 2.50, 2.82) for the CM burger after being anchored to a \$1 reference price for a standard beef patty ( $p < 0.0001$ ). The demand curve highlighted the increased WTP for CM products when using the best framing (**Figure 1**).

Desirability scores for CM patties were 61.5 (95% CI 58.9, 64.0) when framed as environmentally friendly and 68.7 (66.0, 71.4) when framed as the best tasting burgers ( $p < 0.0001$ ).

For the DCE, of those who expressed a preference, 66.7% (95% CI 0.61, 0.72) of respondents stated they would prefer to pay \$2 for a CM patty rather than \$1 for a standard patty when presented with the environmentally friendly framing. When presented with the better tasting framing, 80.0% (95% CI 0.75, 0.84) of respondents stated they would prefer to pay \$2 for a CM patty rather than \$1 for a standard patty ( $p < 0.0001$ ).

On univariate logistic regression analyses, with the outcome of interest switching preferences in favor of CM burgers in the DCE from framing as environmentally friendly to best tasting, men had greater odds of switching in favor of CM burgers when presented with them as the best alternative with an odds ratio of association (OR) of 2.77 (95% CI 1.37, 5.59). Increasing age was associated with a decrease in the odds of switching when framed as the best burger with an OR of 0.96 (0.93, 1.0).

When evaluating the association of WTP at least \$1 (that is, WTP as much or more than a traditional burger) and baseline characteristics, stratified by framing, increasing age was associated with a decreased odds of WTP for both the environmental framing (OR 0.94, 95% CI 0.92, 0.97) and

**TABLE 1** | Demographic and baseline characteristics of respondents, overall and by whether the switched preferences in the DCE in favor of CM burgers when presented as the best option.

Characteristic	Total	Switched DCE response when presented with “best” framing	
		Yes	No
Overall	300 (100)	41 (13.7)	259 (86.3)
<b>Sex*</b>			
Men	140 (47.1)	28 (68.3)	112 (43.8)
Women	157 (52.9)	13 (31.7)	144 (56.3)
Age [mean (SD)]†	29.8 (11.2)	26.6 (8.7)	30.3 (11.4)
<b>Education level</b>			
<High school	6 (2.0)	0 (0)	6 (2.3)
High school	29 (9.7)	6 (14.6)	23 (8.9)
Some college	87 (29.0)	13 (31.7)	74 (28.6)
Associates	30 (10.0)	4 (9.8)	26 (10.0)
Bachelor’s	107 (35.7)	16 (39.0)	91 (35.1)
Graduate	41 (13.7)	2 (4.9)	39 (15.1)
<b>Religious</b>			
Yes	96 (32.1)	11 (26.8)	85 (33.0)
No	203 (67.9)	30 (73.2)	173 (67.1)
<b>Household income [mean (SD)]</b>	68392 (65593)	83830 (72376)	65922 (64255)
<b>Average patties per week</b>			
None	84 (28.0)	5 (12.2)	79 (30.5)
1–2	177 (59.0)	28 (68.3)	149 (57.5)
3–5	30 (10.0)	7 (17.1)	23 (8.9)
6–10	6 (2.0)	1 (2.4)	5 (1.9)
>10	3 (1.0)	0 (0)	3 (1.2)
<b>Pets at home</b>			
Yes	203 (68.1)	26 (63.4)	177 (68.9)
No	95 (31.9)	15 (36.6)	80 (31.1)
<b>Vegetarian/Vegan/Pescatarian</b>			
Yes	25 (8.4)	1 (2.4)	24 (9.3)
No	273 (91.6)	40 (97.6)	233 (90.7)

All values are listed as number (%).

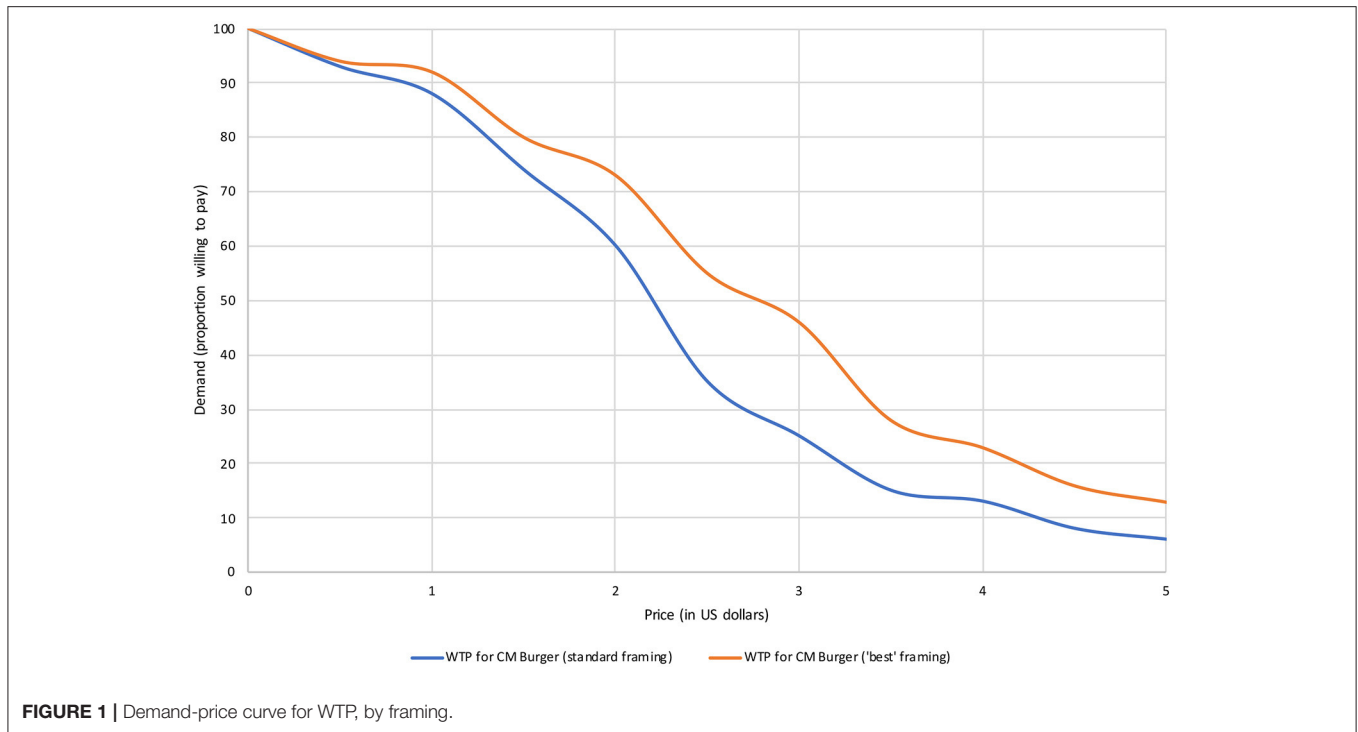
\* $p < 0.003$  by chi squared test.

† $p < 0.05$  by *t*-test.

best tasting (OR 0.95, 95% CI 0.92, 0.98) framing approaches (**Table 2**). Men were more likely to be WTP at least \$1 when framed as the best alternative (OR 3.50, 95% CI 1.26, 9.68), and those who identified as religious were less likely to be WTP at least \$1 when framed as the best tasting option (OR 0.40, 95% CI 0.17, 0.95).

## DISCUSSION

In this first study evaluating societal WTP for CM hamburgers, we found that the majority of respondents were willing to pay more for CM hamburgers than traditional hamburgers; while this willingness was more pronounced when framing CM burgers as the best available option, it persisted even when framing these burgers as environmentally friendly. These findings suggest that



there may be a substantial US market for CM burger products and that manufacturers need not anchor to a price point of equivalency with traditional burgers—which is unlikely to be feasible, particularly in the near future (Bryant, 2020).

We also found that men in particular were more likely to respond to framing the CM hamburgers as the best tasting; whether this was a function of the framing alone or because men were less likely to be swayed by the alternative environmental messaging is an area for future research. Larger studies including sub-populations of interest may be warranted as research in this area progresses, though the increased acceptance of CM by men echoes data from prior studies, further supporting the validity of our findings (Wilks and Phillips, 2017; Slade, 2018; Bryant and Dillard, 2019; Gomez-Luciano et al., 2019b; Shaw and Iomaire, 2019; Bryant and Barnett, 2020; Dupont and Fiebelkorn, 2020; Zhang et al., 2020).

One of the strengths of our study was our use of three separate approaches to assess preferences: a direct WTP approach, a desirability question, and a DCE approach. Critically, all three approaches yielded similar data, demonstrating a WTP more for CM hamburgers whether framed as WTP, increased desirability of CM products, or DCE of preference for paying \$2 for a CM burger over \$1 for a traditional burger. Taken together, this provides robust evidence that CM hamburgers are commercially viable and will be able to command a price premium over standard hamburgers.

Several prior studies have tangentially addressed WTP considerations; one study in a US population found that 15.8% of respondents would be willing to pay somewhat or much more than farmed meat (Wilks and Phillips, 2017). A Belgian study

noted that after providing respondents with some information on CM products, 13.9% stated that they would “surely” pay more, while 43.9% stated that they would “maybe” pay more; after providing respondents with additional information on CM, these numbers climbed to 35.8 and 27.9%, respectively (Wim Verbeke, 2015). A dichotomous willingness to purchase approach has also been used more recently in a multinational sample that included participants in the UK, Spain, Brazil, and the Dominican Republic, where the authors found that perceptions of healthiness may predict positive attitudes to CM (Gomez-Luciano et al., 2019a). The dampened enthusiasm for WTP for CM in these studies may be a function of timing (increased media reporting on CM likely has contributed to increased societal familiarity, which may breed interest and acceptance), as well as population differences between the US, where a *laissez faire* attitude to the naturalness of the food supply prevails and Europe, where greater concern has been raised regarding a range of food technology issues, from genetically modified organisms to nanotechnology (Grobe and Rissanen, 2012; Gupta et al., 2012; Lucht, 2015; de Lorenzo et al., 2018; Bryant et al., 2019).

Biases and heuristics have an established role in the field of consumer neuroscience, as an appreciation of the existence and importance of such decision-making shortcuts, sometimes leading to surprising outcomes, has increased over the past decades (Kahneman and Tversky, 2000). While known biases and heuristics number in the hundreds, none fully explain the tendency for subjects to adjust their valuation of a choice based solely on its framing as the best alternative, when all other descriptors are held constant. We hypothesized the existence of a

**TABLE 2** | Association of willingness to pay as much or more than a traditional burger and baseline characteristics, stratified by framing.

	Framing			
	Environmentally friendly		Best tasting	
	Unadjusted OR (95% CI)	p value	Unadjusted OR (95% CI)	p value
<b>Sex</b>				
Male	1.36 (0.67, 2.73)	0.391	3.50 (1.26, 9.68)	0.016
Female	1 (Reference)		1 (Reference)	
Age (per year)	0.94 (0.92, 0.97)	<0.001	0.95 (0.92, 0.98)	0.001
<b>Vegetarian/Vegan/Pescatarian</b>				
Yes	0.72 (0.23, 2.23)	0.572	0.39 (0.12, 1.26)	0.116
No	1 (Reference)		1 (Reference)	
<b>Religious</b>				
Yes	0.58 (0.29, 1.16)	0.124	0.40 (0.17, 0.95)	0.037
No	1 (Reference)		1 (Reference)	
<b>Education level</b>				
High School	6.79 (0.80, 57.6)	0.079	4.80 (0.55, 42.23)	0.157
Some college	2.39 (0.83, 6.92)	0.107	1.96 (0.61, 6.25)	0.256
Associates	0.48 (0.16, 1.43)	0.190	0.69 (0.20, 2.38)	0.553
Bachelors	2.35 (0.86, 6.46)	0.097	5.94 (1.41, 25.03)	0.015
Graduate/Professional	1 (Reference)		1 (Reference)	

Values are expressed as unadjusted (univariate) odds ratios of association with 95% confidence intervals.

discrete bias favoring choices that are framed as the best available or gold standard—the gold standard bias—and that these choices would systematically be valued more highly than their objective marginal benefit would suggest (Kantor, 2021).

Several associations between baseline demographic variables and measures of WTP are worth mentioning. First, increasing age was associated with a decreased odds of WTP as much or more than a traditional burger, regardless of framing. Each year of age was associated with a 5–6% drop in the odds of being WTP at least the equivalent of a traditional burger for a CM burger. This may be a product of a more traditionalist mindset in older consumers, though further investigation into this finding is needed; regardless, the decreasing enthusiasm for CM with age found in our study echoes prior research in this field, again bolstering the validity of our findings (Wilks and Phillips, 2017; Slade, 2018; Bryant and Dillard, 2019; Mancini and Antonioli, 2019; Shaw and Iomaire, 2019; Bryant and Barnett, 2020; Weinrich et al., 2020; Zhang et al., 2020).

Second, the potential impact of framing on men was particularly powerful: the odds of switching over in the DCE from preferring a standard burger for \$1 to a CM burger for \$2 based on framing as the best option rather than the environmentally friendly option was 2.77 for men. Moreover, examining the baseline WTP as much or more for a CM hamburger than a traditional burger, men had 3.5 times the odds of women in unadjusted analyses. This may be the result of the known tendency of men to be more accepting of CM (Wilks and Phillips, 2017; Slade, 2018; Bryant and Dillard, 2019; Gomez-Luciano et al., 2019b; Shaw and Iomaire, 2019; Bryant and Barnett, 2020; Dupont and Fiebelkorn, 2020; Zhang et al., 2020). Further investigation into

this phenomenon is warranted, since understanding whether men respond preferentially to gold-standard framing may have important and wide-ranging implications.

Finally, those who self-identify as religious appeared less likely to be willing to pay at least as much for a CM hamburger as a traditional hamburger; when framed as the best available burger, the odds ratio was 0.40, suggesting that those who identify as religious may be less willing to consider CM hamburgers. From a marketing and outreach standpoint, it will be important to carefully address this population in future efforts aimed at encouraging CM acceptance, and further research is warranted.

Pricing sends a range of signals to purchases; products that are priced lower than expected may signal to consumers that a product may be inferior, while high prices tend to signal the potential for added value (Jiang et al., 2014; Mastrobuoni et al., 2014). Such signaling is particularly important for products that lack an obvious valuation metric, such as services and some food products, such as meat (Utaka, 2008; Becerril Arreola, 2013). High prices may send aspirational value signals above and beyond baseline measures of legitimacy and quality (Askin and Bothner, 2016), although some have questioned in the past whether such signaling is truly effective (Koku, 1995). Indeed, if consumers believe that CM products have a greater market share they may be more likely to be willing to adopt CM products (Slade, 2018). In the US, USDA grades such as Prime and Choice were introduced in part to provide a reproducible quality metric (O'Quinn et al., 2015); in recent years, the proliferation of measures such as grass-fed, free-range, organic, and other labels have introduced additional complexity in the marketplace. This



complexity may promote a tendency to elide over potential differences, as consumer behavior and behavioral economics studies have highlighted consumers' inability to reproducibly consider more than a handful of options (Carmon et al., 2003; Mick et al., 2004; Novemsky and Kahneman, 2005). Moreover, since CM products will likely be more expensive and have a smaller supply when they come to market, this itself may help drive a cycle of interest and increased WTP, at least in the short term.

This study has several limitations. As with any survey-based research, the generalizability of our findings may be limited, particularly as the population of respondents may not accurately reflect the general US population. Response and social desirability biases are always an issue with survey-based work, though the latter may be partially mitigated by the anonymous nature of the survey. Overall, 28% of respondents stated that they eat <1 burger per week on average; future research better elucidating the differential preferences of those who do and do not regularly consume burgers (beyond a vegetarian/non-vegetarian classification) may be helpful.

In conclusion, we found that respondents were willing to pay more than double for a CM hamburger patty than they would for a traditional burger patty, regardless of framing. These findings have critical implications as companies begin to scale-up

manufacturing capacity and pricing strategies are developed. Future work including developing a demand-price curve for the general US population is warranted, since these findings may have both financial (ideal pricing to maximize profitability) and marketing (framing CM products as a better alternative rather than environmentally friendly) implications.

## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by University of Cambridge Judge Business School. The patients/participants provided their written informed consent to participate in this study.

## AUTHOR CONTRIBUTIONS

JK: study conception. JK and BK: study design, statistical analyses, and writing. JK: oversight. All authors contributed to the article and approved the submitted version.

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**Conflict of Interest:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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