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RESEARCH VIEWPOINT

Public Opinion of Commercial Space Exploration

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ABSTRACT

Utilizing data from a representative survey of Americans, this paper aims to understand who supports commercial space exploration. The findings show parallels to trends previously identified in who supports space exploration. In addition to confirming that knowledge about commercial space is relatively low to non-existent, the data also indicate that respondents do not believe that human spaceflight should be carried out entirely by private actors. Though typical demographic markers associated with support for space exploration, including gender, age, education, and income are identified here as being important, the data indicate that knowledge of commercial space activities is a key mediator for their influence, thereby identifying a key causal mechanism involved in the formation of individual opinion on commercial space that may also be applicable to other elements of public opinion-space studies.

To those inside the space community, it appears to be an exciting time. Between the exploits of commercial space companies such as SpaceX, a planned return to the Moon via the American Artemis program, and increased activity in the domain from states around the world, space seems to be on the minds of people more than ever before. This is particularly the case for activities undertaken by actors such as SpaceX. Their livestreams of launches – including those that do not end well – are routinely watched by hundreds of thousands and the ubiquity of founder Elon Musk only serves to draw more eyes. However, all of this is anecdotal data as to the increasing popularity of and interest in space. As others have rightly pointed out, actual public opinion data on topics related to space are slim.

This paper draws on a unique opportunity to place two space related questions on a nationally administered survey of Americans and represents a first attempt at understanding the contours of mass public opinion on commercial space. The results are rather stunning – despite a tendency of survey respondents to overreport things, such as knowledge, a plurality of respondents reported knowing little to nothing about commercial space.

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AUTHOR NOTE: All views expressed here are the author's own and do not represent the views of the Department of Defense or its associated entities.

Here, I report on the demographic characteristics of support for commercial space, finding that there are both similarities and surprising differences to findings of support in wider studies of space exploration, particularly in terms of race and the intermediate role of knowledge about commercial space. Thus, this study is important in two ways: (1) uncovering the rather significant gap in knowledge about commercial space activities; and (2) showing how patterns of support for commercial space differ from patterns of support for space exploration more generally. This serves as a major reminder that despite the hopes of the space community that all this activity would garner more public interest, that ambition appears to be falling short of the mark.

Background

Prior to examining the literature in this area, it is important to take a step back and define what is meant by commercial space. Perhaps surprisingly, there has been some disagreement over the term's meaning.[1] Almost from the beginning of the space age, non-governmental companies have been involved as contractors, building, deploying, and operating space systems for government clients. In these relationships, clients would request proposals for systems, which the company would then build on behalf of the client with the client having eventual ownership. There is no doubt that these companies could be considered commercial space companies. However, in the context of today's space environment, the term has come to represent companies who are proactive rather than reactive to the market's needs. In other words, what today's commercial space companies, including SpaceX and others, are doing is investing their own money into space systems, which they then contract out as commercial services to clients.[2] This different kind of business model has meant that commercial space companies have sought ways to innovate quickly and reduce costs bringing about major changes to how states and other actors operate in the space domain. The result has been a wide range of space activities that are now undertaken by several private entities, such as space launch, crewed and non-crewed, new means of space-based communications and commercial remote imaging capabilities, and space tourism. Though the survey questions undertaken here focus on commercial human spaceflight, it is important to keep in mind this wide range of commercial operations.

Even under this definition of commercial space, there is one additional objection that can be made; i.e., state governments remain the primary customer and dominate the market in which they are involved. Ken Davidian, former head of the Office of Commercial Space Transportation at the Federal Aviation Administration (FAA), points out two generalized characteristics that help determine the extent to which a space activity is a commercial one: (1) free market driven including the existence of non-governmental

customers; and (2) independence from government.[3] While there certainly are some activities commercial space companies undertake independent from government, such as launching satellite constellations or other non-governmental launches, there has yet to develop a truly free space market independent of government support.

This last point is important for our purposes. If an independent, free space market existed, one might argue that mass public opinion about commercial space does not matter; rather, the invisible hand of the market will dictate the ways in which it develops and operates. However, governments remain heavily involved in commercial space activities, not just by being an anchor tenant, but in the types of legal and regulatory support they provide. In the United States, this has meant several rounds of legislation beginning the 1980s to support the growth of a commercial space industry, limitations on safety regulations of space tourism, and contracting strategies by both NASA and the Department of Defense (DOD) through which the commercial space industry has grown. As long as governments continue to constitute the vast majority of the commercial space market, asking how the public feels about it and how this attitude might influence policy outcomes is a valid one. It is to this first question that we now turn.

Despite space policy being a secondary or tertiary political issue, scholars have spent a good deal of time trying to understand when people do and do not support space exploration.[4] Though Gabriel Almond identified the role of public opinion in space exploration as early as 1960; the fact that the public's response to Sputnik drove most of the Eisenhower Administration's early actions regarding space demonstrates the power of the public.[5] That being said, the field has long suffered from a lack of consistent data over time. Roger Launius highlights that despite beliefs today about a wide base of support for Apollo in the 1960s, the public was decidedly mixed to negatively disposed towards the program.[6] David Burbach, more recently reconfirms this, analyzing several public opinion polls from the 1960s in depth and finding that those who supported, and did not support, Apollo in the 1960s, match very well with the demographic characteristics of space supporters today.[7]

In terms of those demographics, Wendy Whitman Cobb identified the characteristics of those who tend to support exploration, finding that they tend to be younger, male, and Republican, with higher educations and higher incomes.[8] Francois Nadeau, on the other hand, notes some differences, finding that while, male, baby boomers with more education and income are more likely to support greater spending on space.[9] These findings are perhaps not that surprising. More education and more income tend to cluster together, while both women and black Americans, both were actively excluded from the early space program, meaning that neither had many space role models to look to for inspiration. For women in particular, Whitman Cobb also finds a strong influence of college science education on

greater levels of space support.[10] With respect to black Americans, as Neil Maher documents, there has also been a belief that the money spent on such activities could be better spent on social issues that have affected the black community more significantly.[11]

Findings on which political party supports space exploration more have also been mixed. Though some have shown that Republicans are more supportive, others do not find race to be a significant variable.[12] Burbach suggests that this might be due to different foundations for partisan support. He finds that Republicans tend to support space exploration from a place of national security concerns, whereas when Democrats express support, it is for environmental and Earth-based concerns.[13]

More recently, one-off surveys have asked the public about how they prioritize different space missions. On Apollo 11's 50th anniversary in July 2019, Pew reported that Americans see monitoring climate change and planetary defense from asteroids as higher priorities than going to the Moon or Mars.[14] That being said, 50% of respondents in that survey also reported believing that space travel will become more routine over the next 50 years. In a near repeat of the poll four years later, the same top-level findings emerged.[15] However, of note here, this survey did ask about impressions of private space companies. While more respondents believed that private companies were doing a mostly good job, 65% of respondents believed that NASA should continue to play an integral role in space exploration.[16] Though this survey asked several in-depth questions about how private companies were handling things, such as space debris, only "about two-in-ten Americans say they have heard or read a lot about private space companies."[17]

Aside from this one Pew poll, the scholarly literature on space public opinion has yet to more fully examine opinion about commercial space activities. This is to be expected. Until recently, commercial space actors have not played a significant role in space exploration. When the General Social Survey (GSS) asks about whether the United States spends too little, too much, or about right on "space exploration," the assumption is that they are talking about government-sponsored space exploration. However, this assumption may not be valid any longer given the increasing role that private companies, like SpaceX, are playing in the return-to-the-Moon Artemis program.

This trend is reflected in another measure of public opinion on space that has been suggested, Google Trends.[18] Figure 1 shows the frequency of search traffic for the terms "SpaceX" and "NASA" from January 2020 to September 2023. While NASA still garners a higher number of searches than SpaceX, there are points in time, coinciding with major SpaceX events such as its test launches of Starship, where SpaceX surpasses NASA. Though NASA and the U.S. government continue to play a major role in the commercial space industry through the provision of contracts, this suggests that there is

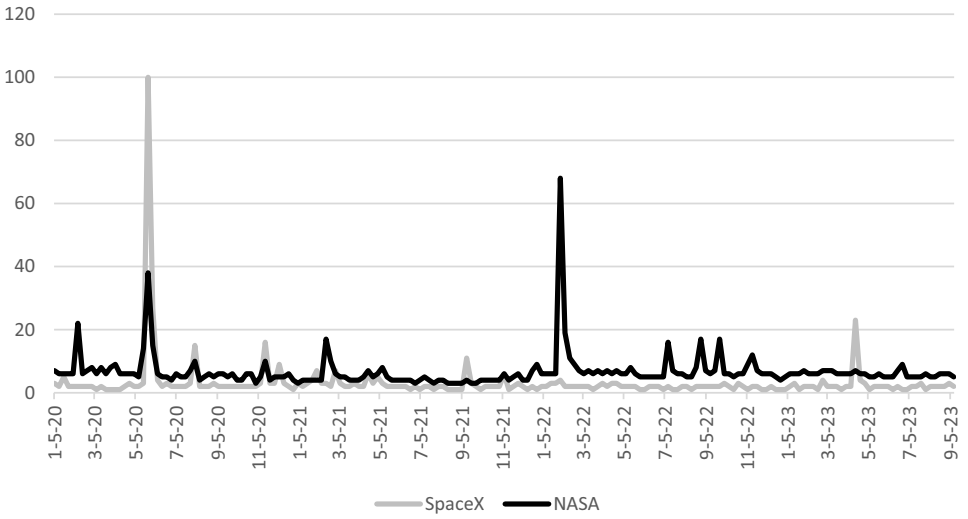

Figure 1. Comparison of "SpaceX" searches and "NASA" Google searches.

a need to consider whether there are differences in public opinion towards commercial space versus traditional space exploration.

In addition to these practical reasons, there are theoretical reasons to expect a difference. One of the historical critiques of government space spending is that the money spent "in space" could be better spent on Earth.[19] If commercial space actors are sinking their own money into these activities and thereby lessening the cost for the government, this could increase support for commercial space. However, there has also been something of a backlash against the commercial space billionaires, such as Elon Musk and Jeff Bezos, along the same critical lines; in other words, why even let the billionaires spend money on outer space when it could be put to better uses alleviating poverty or homelessness?[20] This attitude played a role when a Washington state senator (the home of Blue Origin) attempted to insert language in pending legislation that would have given NASA an additional $10 billion for the lunar landing contracts, money that presumably would have gone to Blue Origin. This effort failed, largely because of the critique that billionaire-owned space companies did not need such bailouts.[21] This attitude might negate any potential benefit commercial space might receive from public opinion and reinforces a mechanism through which public opinion may influence commercial space companies.

One other reason why commercial space might have more support is through its democratizing function. Because of the entrance of commercial space companies, more people, states, and groups have been able to enter space than ever before because of improvements in technology and decreases in cost. Space tourism launches, like those of Virgin Galactic and Blue Origin, are also looking to make space more accessible to the masses. Virgin Galactic,

for example, emphasized the impact of the "overview effect" and the impact that seeing Earth from space has on people.[22] Though these flights remain out of the price range for most consumers, the fact that more people are experiencing this and doing so publicly (for example Michael Strahan's televised flight on Blue Origin's *New Shepard* for the program *Good Morning America*) may increase public awareness and sensitivity to commercial space activities. This greater connection directly to the public and the public's imagination might also mean that there is a difference in opinion.

In sum, despite a dearth of resources, space policy scholars have done a fair job assessing the contours of public support for space exploration, particularly in the United States. However, the rise of commercial space is a wild card in this. How supportive is the public about commercial space? Do the same patterns of support also apply?

Survey methodology

Recently, I was given the opportunity to place two questions on a nationally administered survey by the polling firm Verasight. For its surveys, Verasight draws on a "community" of individuals recruited "via random address-based sampling, random person-to-person text messaging, and dynamic online targeting" with members then authenticated via multiple methods.[23] Participants earn points for taking surveys that can be redeemed for Venmo or PayPal payments or charitable donations, and Verasight takes steps to ensure quality responses by monitoring "low-quality response behaviors over time" and removing those members.[24] This survey was given to 2000 individuals in the United States over the age of 18 with data weighted to match the July 2023 Current Population Survey resulting in a margin of error of ±2.3%.

The two questions of interest here have to do with attitudes about and knowledge of commercial space activities. Knowing that I would have access to the demographic data, in addition to a question assessing support, the second question was about knowledge with the hypothesis that those who know more about commercial space would be more supportive. The first question asked respondents, "To what extent do you agree with the following statement? Human spaceflight generally is best left for private companies, like SpaceX and Blue Origin." The response options were on a scale: strongly disagree, disagree, neutral, agree, and strongly agree. The second question asked, "On a scale of 1–10, how well informed would you say you are about what commercial companies, like SpaceX and Planet, are doing in space?"

There are certainly pros and cons to how these questions were written and structured. Ideally, no company names would be given to potentially cue individuals towards a particular response. However, based on the Pew findings, it is reasonable to assume that knowledge about these types of activities

would be low and believed it would be better to provide examples so that individuals would know what was meant by commercial space. Indeed, the space community often has a hard time defining what commercial space is and is not. In addition, the first question specifies human spaceflight rather than the more general term "space exploration" typically used by the General Social Survey. Again, given a lack of information, people might know more about human spaceflight rather than other space activities. Further, things like remote sensing and communication have long been carried out by private actors. Arguably, one of the differences of this New Space era is that not only is this private activity expanding, but expanding into areas previously only undertaken by government actors.

The demographic variables are measured as follows. Age is an interval variable reflecting the actual age of each participant. Education is measured via six categories coded 1–6: some high school or less; high school graduate or General Educational Development (GED); some college, no degree; 2-year or associate degree; 4-year or bachelor's degree; and post-graduate degree. Gender is measured in three categories, male (coded 1), female (coded 2), and other (coded 3). Income is measured in seven categories coded 1–7: less than $15,000; $15,000 to $50,000; $50,000 to $75,000; $75,000 to $100,000; $100,000 to $150,000; $150,000 to $200,000; and more than $200,000. Race is coded 1 for white, 2 for black, and 3 for Hispanic, and 4 for other. Political party is coded 1 for Democrat, 2 for Republican, 3 for independent, and 4 for other or none.

Given these two questions and the demographic data, I propose seven hypotheses (H).

H1, those who know more about commercial space will be more supportive of commercial space; H2, women will know less about and be less supportive of commercial space; H3, younger individuals will know more about and be more supportive of commercial space; H4, those with more education will know more about and be more supportive of commercial space; H5, Republicans will know more about and be more supportive of commercial space; H6, those with more income will know more about and be more supportive of commercial space; and H7, black Americans will know less about and be less supportive of commercial space. I first present bivariate measures to test these hypotheses and then proceed to utilize linear regression to better understand the import of each variable on the two space questions.

Data analysis

Prior to beginning, it is helpful to briefly discuss the results of the two commercial space questions generally. As to the first, support for private human spaceflight, Figure 2 shows the resulting distribution. A plurality, 42.8%, responded neutrally. In terms of those who did express something

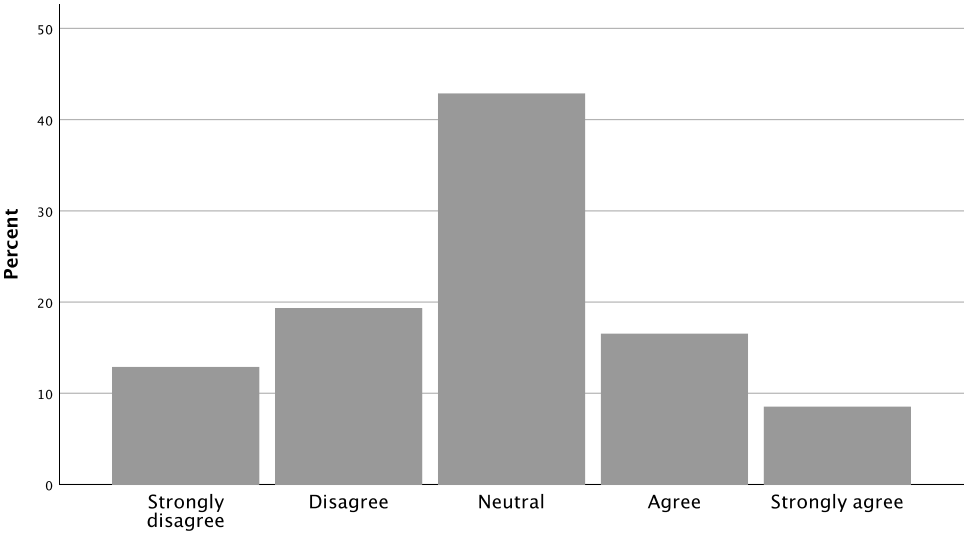

Figure 2. Agree/Disagree that human spaceflight should be done by Private companies.

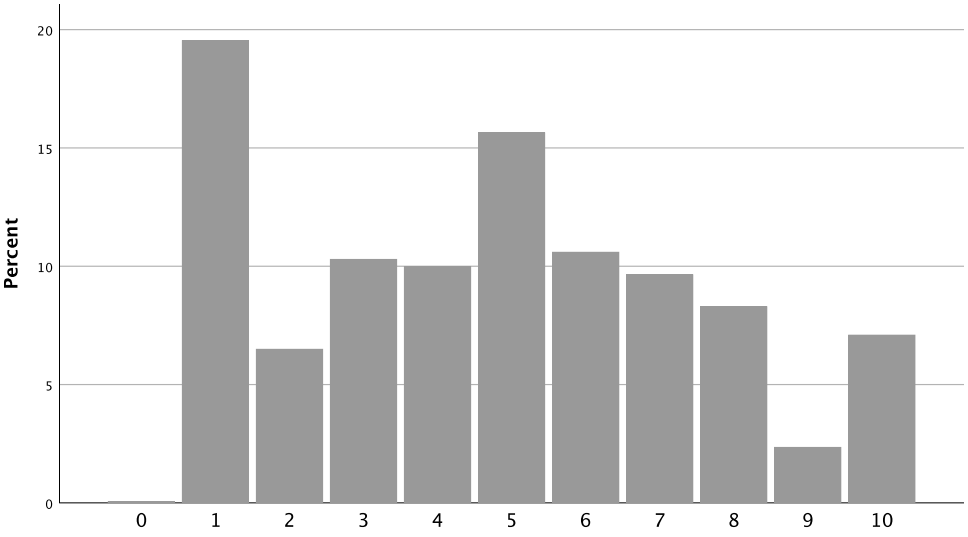

Figure 3. Self-reported knowledge about commercial space.

otherwise, more responded strongly disagree/disagree (32.1%) than strongly agree/agree (25%) suggesting that despite the rise of companies, like SpaceX, people still see a role for government actors in human spaceflight – surely, a comforting finding for NASA and other governmental space agencies globally. Figure 3 shows the results of the knowledge question. Despite there being twice as many answer options in this question than the first, there was still an overwhelming result: a plurality of 19.5% responding that they know little to nothing about commercial

Table 1. Bivariate measures of association for commercial human spaceflight.

	Measure	Result
Knowledge	Pearson's r	0.254***
Gender	Chi-square	54.274***
	Cramer's v	0.116***
Age	Pearson's r	−0.042*
Education	Pearson's r	0.005
Political Party	Chi-square	93.597***
	Cramer's v	0.125***
Income	Pearson's r	0.030
Race	Chi-square	20.565*
	Cramer's v	0.059*

***<0.001, **<0.01, *<0.05.

Table 2. Bivariate measures of association for knowledge of commercial space.

	Measure	Result
Support for commercial space	Pearson's r	0.254***
Gender	Chi-square	117.512***
	Cramer's v	0.171***
Age	Pearson's r	−0.096***
Education	Pearson's r	0.237***
Political Party	Chi-square	67.780***
	Cramer's v	0.106***
Income	Pearson's r	0.220***
Race	Chi-square	34.645
	Cramer's v	0.076

***<0.001, **<0.01, *<0.05.

space. Excluding those who responded with a 5, 46.3% responded 1–4 compared to 37.9% who responded 6–10. This alone is indicative of little knowledge of commercial space activities across respondents.

Table 1 shows the bivariate measures for support for commercial human spaceflight, and Table 2 shows the bivariate measures for knowledge of commercial space. In the first case, knowledge, gender, age, party, and race all appear significant for support for commercial spaceflight, while education and income are not. In terms of knowledge of commercial space, all variables

Table 3. Support for commercial human spaceflight.

	Model 1 B (Std. Error)	Model 2 B (Std. Error)
Constant	2.583 (0.171)***	2.526 (0.065)
Age	−0.001 (0.002)	–
Education	−0.040 (0.019)**	−0.041 (0.016)**
Gender	−0.063 (0.049)	–
Income	0.002 (0.018)	–
Knowledge of commercial space	0.105 (0.009)***	0.107 (0.009)***
Political Party	0.038 (0.025)	–
Race	0.001 (0.024)	–
Model Summary	R^2=0.070 Adj. R^2=0.066	R^2=0.068 Adj. R^2=0.067

***<0.001, **<0.01, *<0.05.

were significant except for race. While these are helpful measures, they do not control for the impact of all the others, thus I turn to regression analysis.

Table 3 shows the results of a regression analysis testing the impact of these variables on support for commercial human spaceflight. In the first model, the only two variables that show a significant influence are education and knowledge of commercial space. Interestingly, the education variable is negative suggesting that those with less education are more supportive of commercial human spaceflight. However, the overall model performance is quite low – those variables only explain about 6.6% of the variation in support for commercial human spaceflight. To try to improve model performance, I removed all variables except education and knowledge of commercial space. In the second model, while those two variables remain significant, knowledge clearly contributes more to the statistical analysis than education. Further, model explanatory power does not change all that much with most of the demographic variables removed suggesting that knowledge of commercial spaceflight is doing much of the heavy lifting in explaining support for commercial human spaceflight.

Since knowledge of commercial space seems to be the most significant influence on support, Table 4 provides the regression analysis seeking to explain its results. Unlike the first analysis, most of the demographic variables are in the predicted direction and are significant in model 1. The one variable that is not significant is race despite showing the appropriate sign. Model 1's performance in this analysis is also much better than the previous set of analyses, with an adjusted R^2 of 0.162.

One objection to this model might be the inclusion of the support variable given that one of the hypotheses being considered is that knowledge leads to support. Model 2 shows the regression without this variable with a surprising result. While all the coefficients retain their approximate value, direction, and significance from model 1 to model 2, leaving the support variable out significantly decreases the model's overall performance to an adjusted R^2 of 0.107.

Table 4. Knowledge of commercial space.

	Model 1 B (Std. Error)	Model 2 B (Std. Error)
Constant	4.055 (0.418)***	5.952 (0.397)***
Age	−0.017 (0.004)***	−0.019 (0.004)***
Education	0.255 (0.044)***	0.246 (0.046)***
Gender	−0.826 (0.114)***	−0.920 (0.117)***
Income	0.149 (0.042)***	0.161 (0.043)***
Support for commercial spaceflight	0.591 (0.052)***	–
Political Party	−0.172 (0.058)**	−0.160 (0.060)**
Race	−0.009 (0.057)	−0.009 (0.059)
Model Summary	R^2=0.165 Adj. R^2=0.162	R^2=0.110 Adj. R^2=0.107

***<0.001, **<0.01, *<0.05.

Based on these findings, there seems to be a causal process not unlike the funnel of causality identified by the authors of *The American Voter* in the mid-20th century.[25] In that, demographic characteristics lead to a particular party identification, leading to attitudes on issues, and finally positions on political candidates. Here, demographics influence who is likely to seek out or know about developments in commercial space, which in turn, leads to support for commercial human spaceflight. In other words, there is an intermediate step from demographics to support in having knowledge.

In terms of the specific hypotheses, the data presented here does support hypothesis 1, the idea that knowledge about commercial space increases support for commercial human spaceflight. The other hypotheses are show mixed results. Gender (hypothesis 2) is important for both knowledge and support in the bivariate analyses, but has no significant impact in support for commercial human spaceflight. With the largest coefficient by absolute value in the knowledge analysis, however, women are less likely to report knowledge about commercial human spaceflight suggesting the importance of the intermediary variable, knowledge. Age (hypothesis 3) presents similarly to gender – significant in the bivariate, not in the regression of support, and significant in terms of knowledge. Education (hypothesis 4) was different – it was not significant in terms of bivariate analysis for support, but was for the rest of the analyses (and in the predicted directions), regressions included.

Political party (hypothesis 5) showed mixed support. While significant in the bivariate analyses, in the analysis of support for commercial space, it was positive (suggesting that Republicans are more supportive), but not significant. In terms of knowledge, however, it was significant and negative suggesting that Democrats know more about commercial space. While these two are certainly not mutually exclusive, this finding adds to the mixed influence of political party. Similarly, for income (hypothesis 6), it was not significantly associated with support in the bivariate analysis, but was for knowledge. In the regressions, income had the appropriate positive sign, but was not important for support, and it was important for knowledge.

The results for race (hypothesis 7) are perhaps the most interesting. Although previous analyses have found this to be important, there is little evidence here that race influences either support for commercial human spaceflight or knowledge of it. While by absolute numbers, there were more whites included in the survey (63.2% white; 12.7% black; 15.6% Hispanic; and 8.4% other), given the disparity in previous findings between white and black support, it still should have played a role here. For reference, in Whitman Cobb's analysis of space public opinion by region, black Americans were around 25% less likely to believe that there was too little spending on space exploration.[26] Another suggestive finding is that black Americans in this survey reported more knowledge about commercial space and more support

for commercial human spaceflight than whites. While this might still be an outlier, these results may also suggest that black Americans feel differently about commercial space compared to traditional, government-run space activities.

Implications and conclusions

This data shows that despite a shift in interest about space with the arrival of commercial space actors, knowledge about and support of commercial space is not as widespread as believed. The fact that 42% of respondents responded knowing little to nothing about commercial space activities despite a proclivity of survey respondents to over report things, such as voting patterns, is surprising.[27] Thus, this paper contributes to the literature on public opinion of space in three ways. One, it is the first exploration of opinion about commercial space and helps set a baseline for what people may or may not know about it. Two, it does show some differences in support, particularly in terms of race with findings on political party support continuing to be mixed. Three, it establishes that, for the most part, the same kinds of people that are interested in and supportive of space exploration are the same that support commercial human spaceflight albeit through the intervening variable of knowledge. Relatedly, knowledge about space activities similarly conditions public opinion on space exploration given that there are some indications in previous research about this role.

This finding may be of importance for promoters of space exploration, both inside and outside government, as it suggests that to increase support for space exploration, a much greater emphasis should be placed on public education. Though there may eventually be limits on how much mass public opinion influences an emerging commercial space market, promoters of the "New Space" commercial effort will continue to need public acquiescence, if not support, for their efforts given the role that government continues to play in supporting the industry. This is evidenced not just by Blue Origin's proposed "bailout", but calls from space leaders at a recent congressional hearing asking for regulatory reform.[28] SpaceX's Elon Musk has often encouraged his supporters to contact regulatory agencies and even politicians as he sought favorable action.[29] Incidents, such as these, support the notion that it is important for New Space leaders to understand how the public feels about commercial space and why. Specifically, these findings indicate that New Space promoters might consider a more organized and comprehensive educational campaign aimed at increasing public awareness of what exactly their goals are and how that benefits society. Further, the data presented here suggest that rather than undertake a typical lobbying effort designed to gather public support, one aimed at increasing awareness and knowledge of

commercial space efforts may be even more important to public support in the long run.

There are limitations here. This survey was given during one week in September 2023 making it merely a snapshot in time. Unlike other research on space public opinion, there is not a large pool of respondents across many years to draw from. Major events also have a way of influencing patterns of support. Thus, while one cannot tell the impact of major events or patterns over time, I can be relatively certain that this is an accurate baseline given that no major commercial space events did happen during that time frame. This assessment is reinforced by the fact that the findings here do fall in line with Pew polling in the topic. Another limitation this survey shares with other space-related public opinion studies is that it does not compare commercial space with other space issues or larger policy priorities. After all, the reason people may not know much about it is because it is not a policy priority. Finally, though the subject of this present study is the mass public, there is a missing group – elite policymakers and space leaders. Future research might focus on this group exclusively to better understand the bases of their own support and even how they view the role of the public in their endeavors.

Future research on this question could be rather fruitful. In addition to tracking the public's attitudes about commercial space over time, investigating how commercial space relates to attitudes, such as economic competition, global political competition, and opinions concerning founders, like Elon Musk and Jeff Bezos, would be of value to the space community. Experimental studies might also be done giving respondents vignettes that pose scenarios to see how they might react; for instance, SpaceX colonizing Mars independently rather than under the direct supervision of the United States. As commercial space actors become increasingly important and integrated in U.S. space policy, understanding how the public views these dynamics will become ever more important to understanding the development of space policy.

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