Non-User Externalities and Market Power*

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Abstract

Firms can increase the demand for their products and consolidate their market power by increasing their users' utility but also by strategically creating negative externalities for competing products' users. We study this mechanism in the smartphone market, analyzing Apple's strategy of marking messages to Android users with distinctive "green bubbles." In surveys with U.S. college students, we show that green bubbles are widely stigmatized and that a majority of both iPhone and Android users would prefer they were removed. An incentivized deactivation experiment reveals that iPhone users require substantial compensation to have their messages appear as green bubbles on other iPhones. Exploiting uncertainty around the DOJ case against Apple, we show that removing green bubbles shifts choices from iPhone to Android. Finally, we document the prevalence of non-user externalities and analyze their implications across a variety of product features.

Keywords: Non-user Externalities; Stigma; Market Power; Consumer Welfare; Antitrust.

JEL Classification: D62, D91, L12, L15, Z13

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1 Introduction

The demand for a product may increase when the utility from consuming it rises but also when the disutility from *not consuming it* increases. This possibility gives companies strategic incentives to design product features that create negative non-user externalities. As a result, users end up paying more for the same product, while non-users bear costs for which they are not compensated. These practices raise welfare concerns, particularly when dominant firms use them to entrench their market power.

Many of the most valuable firms in the world—in technology, social media, and luxury goods—sell products where others' adoption plausibly harms those who do not adopt, whether through degraded interoperability, social exclusion, FOMO, or status losses. In each case, the product imposes costs on those who remain outside, and pressures the consumer to escape the harm by joining the harm generating activity.[1] If a dominant firm's market position partially reflects the degradation of non-users' outside options rather than superior products, standard interpretations of their market power as evidence of value creation would overstate the value these firms create and understate the harm. But despite growing regulatory scrutiny of how dominant firms design their products—from the European Union's Digital Markets Act to the U.S. Department of Justice's antitrust cases against Google and Apple[2]—there is little direct evidence on non-user externalities and their welfare and market implications.

This likely reflects that whether a product feature creates user utility or non-user disutility cannot be distinguished using standard choice data alone. As our model shows, a firm that improves its product and a firm that degrades the experience for non-users produce the same prices, quantities, market shares, and profits in equilibrium. Yet these two cases carry opposite welfare implications: in the first, the firm becomes dominant because it adds more value; in the second, it entrenches its position at the expense of both users and non-users. Distinguishing between them requires direct evidence on the non-user channel—evidence that goes beyond what prices, quantities, and market shares can reveal.

In this paper, we provide evidence on non-user externalities by studying Apple's

[1] A key feature of non-user externalities is that those harmed can mitigate the harm by becoming users (Bursztyn et al., 2026b).

[2] The DMA (Regulation 2022/1925) imposes interoperability obligations on designated "gatekeepers." For assessments of competition policy challenges in digital markets, see Crémer et al. (2019), Scott Morton et al. (2019), and Furman et al. (2019). The DOJ's 2024 case against Apple (No. 2:24-cv-04055) specifically alleges that Apple degrades cross-platform messaging to disadvantage rivals—the practice we study.

green bubbles in the U.S. smartphone market. When an iPhone user receives a message from an Android user, it appears in a distinctive green color rather than the blue used for iPhone-to-iPhone communication. Since Apple's adoption of the RCS messaging standard in 2024, this distinction no longer reflects a technical necessity—yet green bubbles remain, and carry a significant social stigma. Through a series of incentivized experiments using U.S. college students, we show that this feature imposes substantial welfare costs: iPhone users require an average of $49 compensation to have their messages appear green bubbles rather than blue. It also shifts demand: removing green bubbles increases the share of respondents choosing an Android over an iPhone by 46% relative to the baseline. Together, these results demonstrate that a single design choice by a dominant firm's creates economically meaningful non-user externalities and strengthens its product demand—effects that standard choice data would not reveal.

We provide evidence through a series of pre-registered surveys and incentivized experiments with U.S. college students, complemented by cross-market evidence on the breadth of non-user externalities. We first confirm that green bubbles operate through social channels. In a pre-registered survey of 476 U.S. college students, approximately 90% of respondents report that green bubbles stigmatize Android users, commonly associating them with lower social status and attractiveness. A large majority of both Android (79%) and iPhone (67%) users prefer a software change that would make all messages appear as blue bubbles. Most respondents believe that removing green bubbles would enhance the perceived quality of Androids while leaving iPhone quality largely unchanged—evidence inconsistent with green bubbles primarily generating user utility.

In our first experiment, we isolate the welfare cost of green bubbles by eliciting iPhone users' willingness to accept having their messages appear green rather than blue on other iPhones for four weeks—holding all other phone features constant Willingness to accept is elicited via a BDM mechanism. A control group that faces the same hassle and privacy costs of participation but no change to their bubbles allows us to isolate the utility loss attributable to the green-versus-blue distinction alone.[3]

We find that iPhone users require, on average, $49 (median: $25) to have their

[3]The blue bubble deactivation option is not technically feasible. We truthfully inform respondents that only one of two elicited options will be implemented, and always implement the feasible option. Respondents are debriefed at the end of the study. Reassuringly, respondents estimate the likelihood of the hypothetical option being implemented at approximately 50%, similar to their beliefs about the feasible option. Details are in Section 4.

messages appear as green rather than blue bubbles on other iPhones for four weeks. This is significantly above the \$17 (median: \$7.5) required in the hassle-cost control condition ($p < 0.001$). Benchmarked against other features, the median blue bubble valuation of \$25 corresponds to 56% of the valuation of iMessage and 26% of the phone camera, underscoring that the welfare cost of a single design feature, the color of a message bubble, is economically substantial relative to core phone functionality.

In our second experiment, we estimate the demand implications of green bubbles. Respondents interested in buying a new phone make an incentivized choice between an iPhone 16 and a Google Pixel 9 (plus \$150 to equalize market value), conditional on a plausible outcome of the DOJ antitrust lawsuit pending against Apple at the time of the experiment. All respondents are told Apple loses the lawsuit; they are then randomly assigned to a scenario in which the ruling also bans green bubbles or one in which it does not—so that the presence of green bubbles is the only difference between conditions.

We find that removing green bubbles increases respondents' likelihood of choosing the Android option by 7.3 percentage points ($p < 0.05$), a 46% increase from the base rate of 15.8%—substantial shift in relative demand driven by a single design feature. A complementary pre-registered experiment, using a continuous willingness-to-pay measure and a different Android phone (Samsung Galaxy S24 Ultra), confirms the finding: respondents in the blue bubbles group have a \$43 lower willingness to pay for the iPhone ($p < 0.05$). Treatment effects are strongest among single respondents, for whom the social costs of being marked as a non-iPhone user are plausibly highest, while expected changes in network composition and phone resale values play limited roles—consistent with social concerns rather than other equilibrium changes driving the result. Finally, we close by asking whether green bubbles are an isolated case. We survey 500 U.S. college students about hypothetical changes to six product designs, alongside three control features for which we can identify no non-user channel. Respondents expect reversing each design to raise perceived quality for the group it leaves out, a rival's users in some cases and the product's own occasional users in others, at little cost to the product's core users. They attribute these forces to lower perceived social status, exclusion, or pressure to engage more often.

Together, our experimental and cross-market evidence shows that non-user externalities meaningfully affect both welfare and market power, and that green bubbles are not the only design of this kind. This matters for welfare measurement: because the same equilibrium prices and quantities are consistent with both value creation and outside-option degradation, standard tools—consumer surplus, revealed preference, market-share-based instruments—cannot tell them apart. It also matters for policy: if market power partly reflects the strategic degradation of non-users' outside options, remedies that restore interoperability may be insufficient when the underlying externality is social rather than technical.

Our paper relates to three strands of the literature. A classic literature on network industries emphasizes that adoption decisions are interdependent because a product becomes more valuable as its user base grows (Rohlfs, 1974; Farrell and Klemperer, 2007). Recent work demonstrates that these interdependencies can generate *product-market traps*, in which individuals adopt a product because non-participation is costly even though consumers may collectively prefer the product not to exist (Bursztyn et al., 2025a; Akerlof et al., 2026). Bursztyn et al. (2025a) show that such traps arise organically in social media due to the high costs of missing out on social coordination, so that standard consumer surplus substantially overstates welfare. Related work argues that standard demand objects need not coincide with the welfare objects relevant for policy when products generate social spillovers (Bhattacharya et al., 2024; Bursztyn et al., 2025b). Our paper is a supply-side companion to this literature. While existing work takes non-user externalities as a naturally occurring consequence of social interactions, we show that a dominant firm *strategically creates* them through product design—and that this distinction has direct consequences for welfare measurement and market power. The mechanism differs as well. In Bursztyn et al. (2025a) the cost of staying out is missing what everyone else has coordinated on; green bubbles instead mark the non-user and lower their standing in the eyes of others. Our cross-market evidence suggests that lower status is one of several channels a firm can build a design around, alongside exclusion and pressure to engage more often.

Our focus on the strategic degradation of outside options connects to the industrial organization literature on anticompetitive product design. Dominant firms may profit by raising rivals' costs (Salop and Scheffman, 1983) or by selling "damaged goods" that are intentionally degraded to facilitate price discrimination (Deneckere and Preston McAfee, 1996). In network markets, Katz and Shapiro (1985) and Farrell and Saloner (1985) formalize firms' preferences over compatibility, and Farrell and Saloner (1986) how an incumbent can wield incompatibility against a rival's installed base. We document an analogous but distinct *demand-side* mechanism: rather than degrading a rival's technical performance, a firm can degrade the social experience of non-users. Our setting provides a sharp test of this distinction. Apple adopted the

RCS messaging standard yet continues to mark Android messages in green. The externality therefore outlives the technical friction—the focus of Katz and Shapiro (1985) and Farrell and Saloner (1985)—and is now a socially engineered stigma. This logic connects to work on behavioral exploitation (Heidhues and Kőszegi, 2018), though our mechanism operates through social meaning rather than inattention or confusion.

Finally, a long tradition studies how utility depends on relative position and social comparison (Veblen, 1899; Frank, 1985; Bagwell and Bernheim, 1996). Pesendorfer (1995) shows that a fashion monopolist extracts rents by rendering old designs obsolete, deriving conditions under which banning fashion makes all consumers better off—a result closely paralleling the product-market traps in Bursztyn et al. (2025a). Empirical work documents significant willingness to pay for status signaling (Heffetz and Frank, 2011; Bursztyn et al., 2018; Imas and Madarász, 2024). We bring this literature into the context of mass-market technology platforms. Unlike standard status goods where demand reflects the private value of signaling prestige, our evidence shows that demand is also driven by the desire to *avoid* firm-controlled stigma. This shifts the focus from consumers who seek status to firms that manufacture social costs—and from voluntary signaling to strategically imposed differentiation.

The paper proceeds as follows. Section 2 formalizes the competitive and welfare implications of non-user externalities in a simple model. Section 3 provides institutional background on the smartphone market and presents survey evidence on green bubble stigma. Sections 4 and 5 present the deactivation and demand experiments. Section 6 shows evidence from other product features. Section 7 concludes.

2 A Model of Strategic Non-User Externalities

Two firms, A and B, sell an indivisible product at prices p_A and p_B, with equal and constant marginal cost $c > 0$. A continuum of heterogeneous consumers, with a total mass of one, must choose one of the two products.[4] Consumers have utility that is quasilinear in income, with utility u^i_A from product A and u^i_B from product B, distributed according to a smooth distribution with full support.

We assume that firm A can adjust its product design to create *non-user externalities* g on consumers of B—as when Apple distinguishes messages sent to Android

[4] There is no outside option. This matches markets where adoption of *some* product is near-universal—as in smartphones, where over 99% of U.S. undergraduates own a device and Apple and Android jointly hold a market share above 99%.

phones with green bubbles, generating social stigma against non-iPhone owners.[5] For simplicity, we take the decision to create non-user externalities as exogenous and assume only one firm can do so, but we microfound both features in Appendix A.2. In the microfoundation, both user utility and non-user externalities arise from social image concerns: when consumers care about the composition of each product's user base, only the firm with a "better" composition of users (the one relatively more associated with high types) benefits from amplifying stigma.[6]

After firm A's product design choice g, both firms compete in prices. Consumers solve:

$$\max\{\, u_A^i - p_A,\ \ u_B^i - g - p_B \,\}. \tag{1}$$

Let $Q(p_A - p_B - g)$ denote aggregate demand for product A, with $1 - Q$ the demand for B.

Assumption 1. *The density f of the difference in utilities, $u_A^i - u_B^i$, is log-concave.*

Lemma 1. *Under Assumption 1, there exists a unique Bertrand-Nash equilibrium.*

Strategic incentives. Consider firm A's product design decision. Suppose it can marginally and costlessly create negative non-user externalities by increasing g.

Proposition 1 (Market power)**.** *When firm A marginally and costlessly increases non-user externalities g, its markup, market share, and profits increase. The markup, market share, and profits of firm B decrease.*

The increase in g gives firm A a strategic advantage by shifting demand toward its product. This creates upward price pressure on A and downward pressure on B, but neither adjustment fully offsets the demand shift.

Observational equivalence and the welfare wedge. Equilibrium prices and quantities would be identical if firm A had instead increased user utility by g. When consumers solve $\max\{u_A^i + g - p_A,\ u_B^i - p_B\}$, demands are unchanged. The source of the increase in g does not alter the market equilibrium. However, it matters for welfare.

[5] In practice, what matters is consumers' *expectations* about g: consumers select firm A specifically to avoid incurring the cost and therefore never actually experience it.

[6] The firm with a "worse" composition would not deepen the stigma, since doing so would decrease its own demand.

Proposition 2 (Welfare)**.** *In equilibrium, consumer welfare decreases when firm A creates non-user externalities and increases when firm A creates user utility.*

The two cases are observationally equivalent in prices, quantities, and profits, but carry opposite welfare implications. When firm A creates user utility, its consumers benefit from a quality improvement that more than offsets the price increase, while B's consumers benefit from downward price pressure—the firm becomes more dominant because it adds more value. When firm A creates non-user externalities, both groups are worse off: A's consumers pay more for the same product, and B's consumers experience worse utility without adequate price compensation.

Implications for identification. Propositions 1 and 2 imply that standard choice data on prices and quantities cannot distinguish welfare-improving innovation from welfare-reducing non-user externalities. This identification challenge is sharpest in markets without an outside option: when all consumers must choose one of the two products, the welfare effects of a feature like green bubbles are not revealed by within-market substitution patterns alone. Identification then requires evidence on each side of the market separately: whether the feature lowers the utility of the rival's users, or raises that of the firm's own. Section 3.2 provides that evidence for green bubbles; Sections 4 and 5 then measure what the feature costs non-users and what removing it does to demand.

Proofs are provided in Appendix A. The microfoundation in Appendix A.2 endogenizes both the non-user externality term g and the asymmetry in which firm creates it.

3 The Smartphone Market: Background and Stigma

3.1 Institutional Background

The U.S. smartphone market. The U.S. smartphone market is dominated by Apple, especially among younger consumers. Roughly two-thirds among 18–29 year olds, and close to nine-tenths among teenagers have an iPhone. Android's U.S. presence is led primarily by Samsung, with Google Pixel growing from a smaller base. Appendix B.1 provides details on valuation, sources, and cross-country comparisons in market shares.

iMessage and green bubbles. In 2011, Apple introduced iMessage, a proprietary messaging platform that became the default texting protocol between Apple devices. Prior to iMessage, all messages between phones were sent via SMS/MMS (and appeared as green bubbles). After iMessage, when an iPhone user texts another iPhone, the message is routed through iMessage and appears as a blue bubble. When an iPhone user texts an Android phone, however, the message falls back to SMS/MMS and appears as a green bubble. Figure 1 shows this difference.

Because iMessage is the default for iPhone-to-iPhone texts, green bubbles strongly signal that the sender is an Android user. For most of iMessage existence, SMS/MMS lacked typing indicators, read receipts, and high-quality media. These gaps that may have reinforced an association between green bubbles and lower-quality devices.

In September 2024, Apple's iOS 18 update introduced support for Rich Communication Services (RCS) for iPhones, which closed most technical compatibility issues (Apple Inc., 2024).[7] The color distinction, however, remains: messages with Android users still appear as green bubbles.

Antitrust scrutiny. In March 2024, six months before the iOS 18 update, the DOJ and 16 state attorneys general filed an antitrust lawsuit accusing Apple of violating Section 2 of the Sherman Act (U.S. Department of Justice, 2024). The lawsuit argues that Apple deliberately degrades cross-device messaging to create social stigma against Android users. Internal communications support this claim. In 2013, Apple's Senior Vice President of Software Engineering noted that cross-platform iMessage "would simply serve to remove [an] obstacle to iPhone families giving their kids Android phones." In 2016, Apple's SVP of Worldwide Marketing wrote to CEO Tim Cook: "moving iMessage to Android will hurt us more than help us" (U.S. Department of Justice, 2024). Appendix B.2 provides a detailed discussion.

Green bubbles as a strategic choice. When Apple introduced blue bubbles in 2011, the color distinction likely served a technological purpose: signaling which protocol carried a message. Over time, green bubbles became widely associated with lower status, particularly among younger users—a phenomenon repeatedly covered in the popular press.[8] Apple's decision to maintain the distinction—even now that RCS has closed the main compatibility gaps—is consistent with a deliberate strategy.

[7] Apple may have adopted RCS in anticipation of the DOJ lawsuit and European Digital Markets Act (U.S. News & World Report, 2024). See next paragraph.

[8] See, e.g., Higgins (2022) in the *Wall Street Journal* and Chen (2023) in the *New York Times*.

Figure 1: Blue versus Green Bubbles on iPhones

(a) Blue Bubbles (iMessage) **(b)** Green Bubbles (SMS/MMS)

Notes: Panel (a) displays iPhone-to-iPhone communication via iMessage; text is shown as blue bubbles. Panel (b) displays iPhone-to-Android communication via SMS/MMS; text is shown as green bubbles. While SMS/MMS can occur between iPhones, texts on iPhone are routed through iMessage by default so that green bubbles strongly signal an Android sender. Images from Apple Support (2024).

When asked at a 2022 conference about cross-platform compatibility issues, Cook responded: "Buy your mom an iPhone." Apple has not promoted the RCS improvements in iOS 18 despite persistent user dissatisfaction. Android manufacturers, by contrast, actively highlight them in advertising.

3.2 Survey Evidence on Green Bubble Stigma

To quantify the phenomenon, we survey U.S. college students on their perceptions of Android users, their preferences over the green bubble feature, and its perceived effect on product quality.

3.2.1 Sample

We recruited 476 U.S. college students (aged 18–22) through Prolific in September 2024, prior to the iOS 18 release.[9] The resulting sample reflects the natural distribution of phones in this population: 84% iPhone users and 16% Android users, closely matching observed market shares. We focus on college students because this is the population where social social image concerns, dating market considerations, and lock-in from early brand adoption concentrate.

3.2.2 Design

The survey is designed to identify whether green bubbles generate stigma and to distinguish user-utility from non-user-externality channels.

We first elicit unprompted associations about Android users. Before any mention of green bubbles or the DOJ lawsuit, we ask: "When you think of someone who owns an Android instead of an iPhone, what comes to mind?" Two research assistants independently hand-code responses into seven non-mutually-exclusive categories, with LLM-based classification as a robustness check.[10]

We then measure preferences over the color distinction feature. We inform respondents that iOS 18 resolves most technical compatibility issues between communication between iPhones and Android phones. We then ask whether respondents would prefer a software change that replaces green bubbles with blue bubbles for all users.

[9] The survey was preregistered on AsPredicted (#188972); see `https://aspredicted.org/r27m-69c8.pdf`. Appendix Table A2 provides summary statistics.

[10] Appendix C.2 details the coding scheme.

Finally, we measure the perceived impact of removing green bubbles on the quality of both phones. A preference for removal could reflect either increased user utility or reduced non-user externality. The perceived quality impact for iPhones and Android phones distinguishes between them.[11]

3.2.3 Results

Android stereotypes. Figure 2a shows the most frequently mentioned association with Android users classifies under *Stigma and Social Status* (34.5%), with respondents spontaneously associating Android ownership with lower social standing (e.g., "I think they are someone more average. They are not as wealthy. They also have fewer friends"). Other frequent categories include demographic associations (24.2%)—primarily that Android users are of older age—financial and practical references (25.8%); and technical comments (23.9%). 10.3% of respondents explicitly mention green bubbles unprompted, and 28.6% of these also raise stigma concerns.[12] Stigmatizing references come predominantly from iPhone users; Android users instead emphasize personality traits.

Structured questions that we follow up with confirm these patterns. An overwhelming majority (90%) of respondents state that there is a social stigma against Android users. Respondents perceive Android users as earning 10.5% lower incomes than iPhone users. A large majority of iPhone users (90%) and a majority of Android users (57%) perceive iPhone users as more attractive than Android users. Appendix C.5 presents the full results.

Preferences. Figure 2b shows that a large majority of Android users (79%) and a majority of iPhone users (67%) prefer removing green bubbles for all phone types. Open-text explanations reveal that social stigma is the dominant reason among Android users; iPhone users cite both stigma reduction and improved user experience (Appendix C.2).

Perceived quality. Removing green bubbles substantially improves the perceived quality of Androids, while leaving iPhone quality unchanged for over 60% of respondents (Appendix C.5). Only 10% perceive iPhone quality as *higher* with green bub-

[11]The full survey design and instructions are in G.2. Additional results are discussed in Appendix C

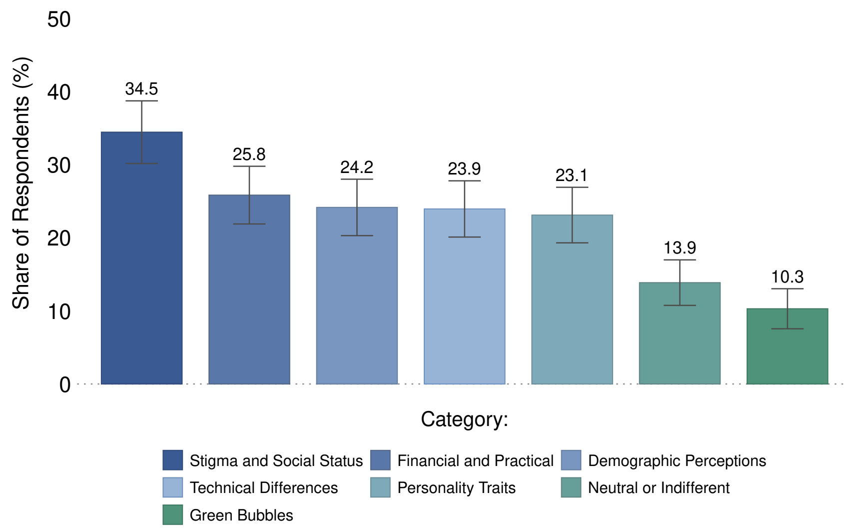
[12]97% of respondents were aware of the green bubble feature prior to the survey.

bles. This asymmetry—green bubbles degrade the outside option without improving the focal product—is the signature of non-user externalities rather than user utility.[13]

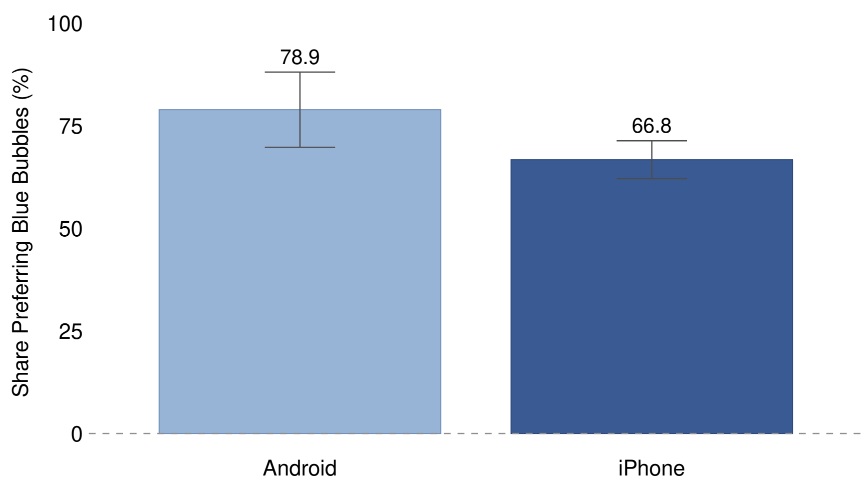
Taken together, the descriptive evidence yields three findings: green bubbles are widely associated with social stigma, majorities of both iPhone and Android users would prefer their removal, and the feature primarily degrades the perceived quality of Androids rather than enhancing the perceived quality of iPhones. The next two sections quantify the welfare cost of this stigma (Section 4) and its impact on product demand (Section 5).

[13] Open-ended responses suggest the small "higher quality with green bubbles" response reflects a minor signal-detection value (rather than a widespread utility benefit): only 9% of respondents cite the ability to distinguish Android from iPhone users as a reason to keep green bubbles.

Figure 2: Android Stereotypes and Preferences over Green Bubbles



(a) Unprompted Stereotypes About Android Users



(b) Preference for Removing Green Bubbles

Notes: Panel (a) displays the share of responses classified into each category for the open-ended question "*When you think of someone who owns an Android instead of an iPhone, what comes to mind?*" Categories are non-mutually exclusive; two research assistants coded responses independently, then reconciled differences. LLM-based classification yields similar results (Appendix C.2). Panel (b) displays the fraction of respondents who prefer a software update making all messages appear as blue bubbles, by phone ownership; respondents were informed that iOS 18 had already resolved most compatibility issues (typing indicators, read receipts, media quality) and that this change would only affect bubble color. Error bars in Panel (b) are 95% confidence intervals. $N = 476$ in both panels.

4 The Welfare Costs of Non-User Externalities

In this section, we quantify the disutiltiy of green bubbles using an incentivized deactivation experiment.

4.1 Sample

Recruitment. We recruited a sample of college students aged 18 to 25 through College Pulse, restricting eligibility to iPhone users.[14] We run the experiment in October 2024, after the mid-September release of iOS 18, which had resolved most cross-platform interoperability issues other than the bubble color itself.

Preregistration. Our data collection was preregistered on AsPredicted (#195544).[15]

Sample characteristics. Of the eligible respondents who reached the consent screen, 83% consented to the incentivized portion of the study. We interpret this as a high consent rate given the study's duration and requirements for personally identifiable information (PII)—a four-week deactivation requiring their phone number and screenshots of phone settings[16]. We were unable to collect incentivized data from the 17% who declined, so our estimates speak to the average welfare loss among consenters. Selection likely biases this estimate downward, as respondents with the highest social costs of deactivation are presumably least willing to participate.[17]

Applying our pre-registered eligibility, comprehension, attention, and duplicate screens leaves 386 participants.[18] Excluding a further 42 respondents to account for a coding error leaves a final analysis sample of 344 participants.[19] Appendix Figure A11

[14] Unlike our other data collections, which use Prolific (Appendix Table A23), this experiment requires phone numbers, which College Pulse, a company specializing in recruiting U.S. college students for online survey, permits.

[15] The preanalysis plan includes the experimental design, hypotheses, primary and secondary outcomes, sample size, and exclusion criteria. For details, see `https://aspredicted.org/xxyp-s8qx.pdf`.

[16] The consent rate also compares favorably to related work; 57% in Bursztyn et al. (2025a) and 43% in Allcott et al. (2020)

[17] Even if the 17% who declined are indifferent between blue and green bubbles, our estimates still imply substantial disutility from green bubbles.

[18] The pre-registered duplicate criteria remove 7 observations at this stage.

[19] Some respondents who regretted their initial valuation experienced a minor coding error that caused the re-elicitation MPL to skip certain increments (e.g., an ascending MPL omitting the $60 increment between $0 and $150). To be conservative, we exclude all respondents ($N = 42$) who regretted their initial valuation for Choice 1 or Choice 2 from our primary analysis.

shows that results are virtually unchanged on the full 386-participant sample. The final sample is 57% female with mean age 20.5; Appendix Table A8 reports full demographics.

4.2 Design

We randomize respondents twice: first into the blue bubble deactivation treatment or the privacy and hassle cost control, then into iMessage or camera as the benchmark good. Each respondent reports WTA for both their assigned deactivation (Option 1) and their assigned benchmark (Option 2). Appendix Figure A8 shows the full experimental flow.

Shared setup. Before consenting, participants are told they will be asked their willingness-to-accept (WTA) for two different deactivation options. We elicit WTA via a BDM procedure with an ascending multiple price list (MPL).[20] To prevent differential selection, we provide identical information across arms before consent. Respondents are truthfully told that one in ten participants will be selected for implementation, and that only one of their two options will be implemented if selected.[21] Respondents are randomly assigned to one of two arms: a "blue bubble deactivation" treatment and a "privacy and hassle cost" control.

Treatment arm: blue bubble deactivation. In Option 1, treatment respondents report their WTA to deactivate blue message bubbles on their phone. For four weeks, all iMessages they send would appear as green bubbles—instead of blue—on both their own and recipients' iPhones. We emphasize that everything else about their phone remains constant.[22]

Control arm: privacy and hassle cost. In Option 1, control respondents report their WTA to participate in a study that involves uploading a settings screenshot

[20] Offers range from $0 to $150, in $5 increments up to $20 and $10 increments thereafter.

[21] In practice, only Option 2 is feasible, so it is always the implemented option for selected respondents. We debrief them at the end of the study.

[22] Some users may nonetheless believe deactivation removes their ability to distinguish others' phones, despite our framing. Survey evidence in Section 3.2 suggests this is not the primary concern: a majority of iPhone users prefer removing green bubbles, and only 9% of open-text responses cite signal detection as a reason to oppose the hypothetical removal. In any case, deactivation in our study leaves the iMessage-vs-SMS distinction on incoming messages intact, and iPhone-exclusive features such as FaceTime and location sharing continue to mark the platform divide.

and receiving a weekly text at a random time, with no changes made to their phone. This isolates the disutility of green bubbles from the privacy and hassle costs of study participation.

Benchmark goods (Option 2). In Option 2, respondents in both arms are randomized into one of two benchmark goods: iMessage or the phone camera. They report their WTA to disable the assigned good for four weeks. For iMessage deactivation, we verify compliance via a settings screenshot and a weekly text sent at a random time. For camera deactivation, we verify via a settings screenshot and a weekly screen-time report at a random time. The blue-bubble deactivation differs from the iMessage deactivation in that participants retain iMessage functionality; only the bubble color changes. We need both because, even after iOS 18, iMessage and RCS differ in features beyond bubble color (e.g., end-to-end encryption); the blue-bubble deactivation isolates the welfare effect of green bubbles, while iMessage deactivation serves as the benchmark.

Discussion of borderline deception. Our design requires measuring WTA to deactivate blue bubbles, but this option is technically infeasible (no setting toggles bubble color independently of iMessage). We do not outright deceive participants — they are truthfully told that only one of two options will be implemented — but the design does rely on participants believing the blue-bubble deactivation is feasible. We adopted this approach because we judged it the only practical way to elicit incentivized WTA for green-vs-blue bubbles specifically. In the treatment arm, we debrief participants about Option 1's infeasibility at the end of the survey.[23]

4.3 Results

Figure 3 shows that iPhone users require an average compensation of \$49 to have their messages appear as green rather than blue bubbles for four weeks. This is \$32 more than the average WTA of \$17 in the control arm, where respondents perform the same study chores without any change to their phone ($p < 0.001$). The median gap between arms is similarly large (\$25 vs. \$7.5, $p < 0.01$). Because the only difference between arms is whether messages display as green or blue bubbles, the gap isolates the disutility of green bubbles from the privacy and hassle costs of study participation.

[23] Compliance with the implemented deactivation was high (95%), which suggests participants took the instructions seriously.

This finding is consistent with the stigma evidence in Section 3.2: respondents require compensation to bear the negative associations of being perceived as an Android user.

The valuation of avoiding green bubbles is large relative to the WTA for deactivating widely-used phone features. We focus on medians, which are unaffected by top-coding at our maximum offer of \$150.[24] The median WTA to display green bubbles (\$25) is 26% of the median WTA to deactivate the phone camera (\$95) and 56% of the median WTA to deactivate iMessage entirely (\$45). This iMessage comparison is an upper bound on the welfare cost of green bubbles, since iMessage deactivation removes substantive features beyond bubble color (such as end-to-end encryption and location sharing). Respondents thus place a relatively high value on avoiding green bubbles relative to these benchmark features, underscoring the economic significance of the welfare cost.

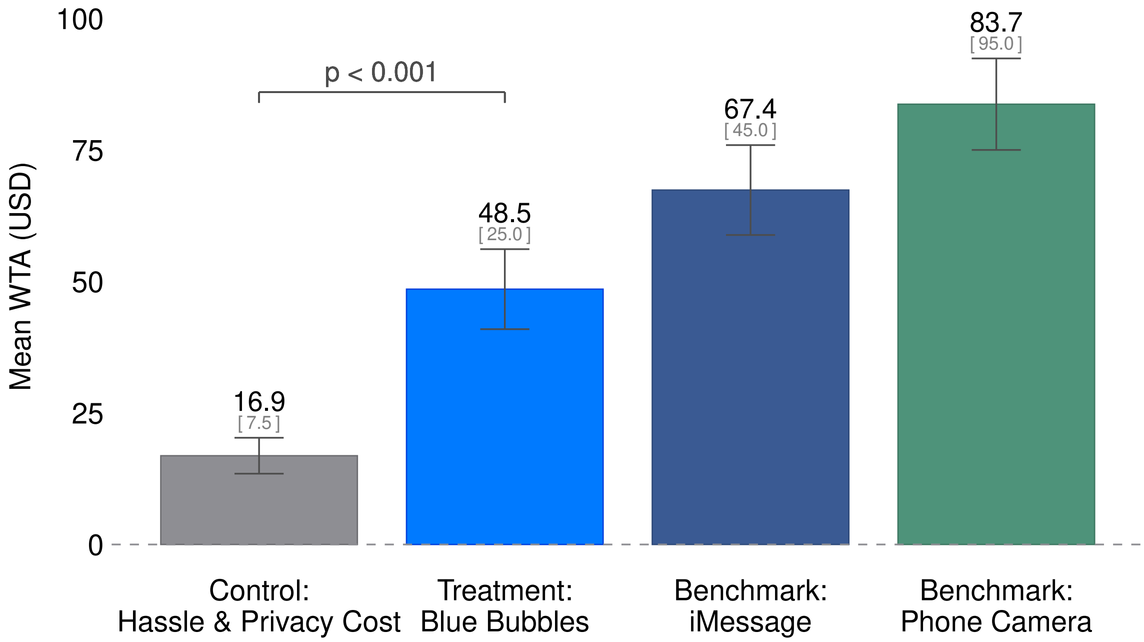
4.4 Robustness

Perceived credibility. Our design relies on respondents believing that the blue bubble deactivation is technically feasible. To evaluate this, we ask respondents to rate the likelihood of each option being implemented; the benchmark probability is 50% if respondents perceive the selection as a fair coin toss. As shown in Appendix Figure A9, perceived likelihoods are similar across options, ranging from 37% to 47%, and the blue bubble deactivation has the highest perceived likelihood of all options. Treatment effects are also similar across respondents with different perceived credibility (Appendix Table A10).

Top-coding. A non-trivial share of WTA responses are top-coded at our maximum offer of \$150: 12.3% for blue bubbles, 0.0% in the control, 25.3% for iMessage, and 36.5% for the camera. The differential rates bias the mean comparisons in opposing directions: the mean treatment-control gap is biased downward (top-coding is more prevalent in treatment than control), while the mean blue-bubble-vs-benchmark gaps are biased upward (top-coding is more prevalent for the benchmark goods). We therefore benchmark on medians in our main results, which are unaffected by top-coding for any condition with fewer than 50% top-coded responses. Appendix D.5 shows that our results are robust to alternative top-coding thresholds, including imputing

[24] The camera valuation is comparable to Brynjolfsson et al. (2025), who report a median WTA of €68 to deactivate the phone camera, with a 95% confidence interval of €34 to €137.

Figure 3: WTA to Deactivate Phone Features by Treatment



Notes: This figure displays willingness-to-accept (WTA) to deactivate different features of participants' iPhones for four weeks, by treatment. Bars show means in USD; values in brackets below show medians. Error bars are 95% confidence intervals around the mean. The bracketed comparison reports the p-value for the difference in mean WTA between the Hassle & Privacy Cost (control) and Blue Bubbles deactivation (treatment) conditions.

top-coded values from a parametric tail and re-estimating with offer ranges extended above $150 in a separate sample.

Other robustness. Our estimates are not driven by particular subgroups or specifications. Treatment effects are similar by gender and relationship status (Appendix Table A10). Adding demographic controls leaves point estimates essentially unchanged (Appendix Table A9). Excluding respondents who regretted their initial valuation, rather than only the subset affected by the coding error, also leaves results unchanged (Appendix Figure A11).

5 Non-User Externalities and Product Demand

Having established large negative welfare effects of green bubbles, we next turn to their market implications. In this section, we measure how green bubbles affect demand for iPhones using an incentivized choice experiment that varies whether the DOJ lawsuit results in a ban on green bubbles.

5.1 Sample

Recruitment. Similar to our previous data collections, we recruited a sample of US students aged 18 to 25 through Prolific. The data collection was carried out in November and December 2024.

Preregistration. This experiment was preregistered on AsPredicted (#201569).[25]

Inclusion criteria. As pre-specified, we screen for U.S. students aged 18–25 who own an iPhone, are actively considering purchasing a new phone, and do not already own an iPhone 16, the experimental prize. This is the population most directly exposed to the non-user externalities of green bubbles: as iPhone owners they currently contribute to Apple's market position, and as prospective buyers they are the margin on which demand effects operate.

We additionally pre-specified data quality exclusions for attention check failures, repeated regret over the phone choice, duplicate Prolific IDs, and high fraud or low

[25] The preanalyis plan includes the experimental design, hypotheses, primary and secondary outcomes, sample size, and exclusion criteria. For details, see `https://aspredicted.org/54y4-s5jj.pdf`.

reCAPTCHA scores. We also implemented bot prevention measures, including randomized validated text-input questions at the start of the survey. Appendix E.4 provides full details.

Sample characteristics. After applying our data-quality and attention-check exclusions, our initial sample consists of 575 respondents. We further exclude 107 respondents who did not meet our screening criteria, leaving a final sample of 468 respondents.[26] The sample is 61% female with mean age 21.5; Appendix Table A11 reports full demographics.[27]

5.2 Design

We randomize respondents into one of two DOJ lawsuit outcomes: green bubbles persist (active control) or are banned (treatment). All respondents receive identical information about the phone choice, the lottery procedure, and the lawsuit, and then make a single binary choice between an iPhone 16 and a Google Pixel 9 plus $150 under their assigned scenario. Appendix Figure A12 shows the full experimental flow; Appendix G.4 contains the instrument.

Phone choice and prize framing. Respondents are told that, following the survey, a lottery will be held in which they could win a new smartphone. They choose between two options: an iPhone 16 or a Google Pixel 9 plus $150. Both were top-selling flagship phones at the time of the experiment, released in fall 2024, and rated as comparable in overall quality (camera, battery, display) by independent reviews.[28] The $150 was set to equalize the market prices of the two options at the time of the experiment ($800 for the iPhone 16, $650 for the Pixel 9, the latter reflecting Black Friday and Cyber Monday discounts on the Google Store).

Lottery procedure. Respondents are told that one in 500 participants will be selected as a lottery winner and will receive their chosen phone, sent to an Amazon

[26] We accidentally collected responses from non-students, non-U.S. citizens, respondents aged 26–27, and respondents who own a version of the iPhone 16. Our results are virtually identical when including all 575 respondents, as seen in Table A15.

[27] Given Prolific's sample availability under our screening criteria, we prioritized maximizing sample size over balancing gender. Table A13 shows that treatment effects are if anything stronger for males, mitigating concerns about gender imbalance.

[28] Quality comparisons draw on expert reviews and rankings from DXOMARK.

locker or PO box near their zip code to preserve anonymity. Because their stated choice determines which phone they receive if selected, it is in their interest to respond truthfully. A comprehension question verifies understanding before respondents proceed.[29]

DOJ lawsuit information. Respondents are then reminded that messages between iPhones appear as blue bubbles, while messages between iPhones and Androids appear as green bubbles on iPhones. They are introduced to the DOJ lawsuit against Apple, which alleges anti-competitive practices around iMessage and specifically highlights green bubbles. We tell respondents that, as a result of the lawsuit, Apple might be compelled to eliminate green bubbles and standardize blue bubbles across all devices, with the trial expected to commence in the coming months. After receiving this common information, respondents are randomized into one of two scenarios describing the lawsuit's outcome.

Active control: Green bubbles persist. In the active control, respondents choose their preferred phone in a scenario where Apple loses the DOJ lawsuit and faces significant fines, but green bubbles are not banned. Respondents are explicitly told that messages between iPhones and Androids would continue to appear as green bubbles, accompanied by a screenshot illustrating this.

Treatment: Green bubbles banned. In the treatment, respondents choose their preferred phone in a scenario where Apple loses the DOJ lawsuit and faces significant fines, and green bubbles are banned. Respondents are explicitly told that messages between iPhones and Androids would now appear as blue bubbles, accompanied by a screenshot illustrating the change.

Design discussion. We elicit a simple binary choice to keep the elicitation method straightforward while capturing the market share of both operating systems, our key metric for assessing market power. We focus exclusively on iPhone and Android phones because they account for over 99% of the overall market share. These design choices enhance the external validity of our measure for actual purchasing decisions.

We use an active control design in which both treatment scenarios involve Apple losing the lawsuit, so that the only difference between arms is whether the loss leads

[29]Respondents who fail the comprehension question are excluded from the analysis sample.

to a ban on green bubbles. This minimizes differences in beliefs about other potential impacts of the lawsuit between arms.[30] The active control also mitigates differential experimenter demand effects across arms (Haaland et al., 2023). The incentivized nature of our outcome data further mitigates experimenter demand and social desirability biases (Bursztyn et al., 2026a), which appear unlikely in any case given the heterogeneous treatment effects discussed later.

5.3 Results

Figure 4 shows that respondents in the blue bubble treatment are 7.3 p.p. more likely than those in the green bubble treatment to choose the Google Pixel option ($p < 0.05$) — a 46% increase relative to the green bubble baseline of 15.8%. These results provide strong evidence that a product feature, by reducing non-user externalities, can significantly increase demand for the product. In this case, green bubbles meaningfully contribute to the iPhone's dominant market position in the U.S.

5.4 Mechanisms

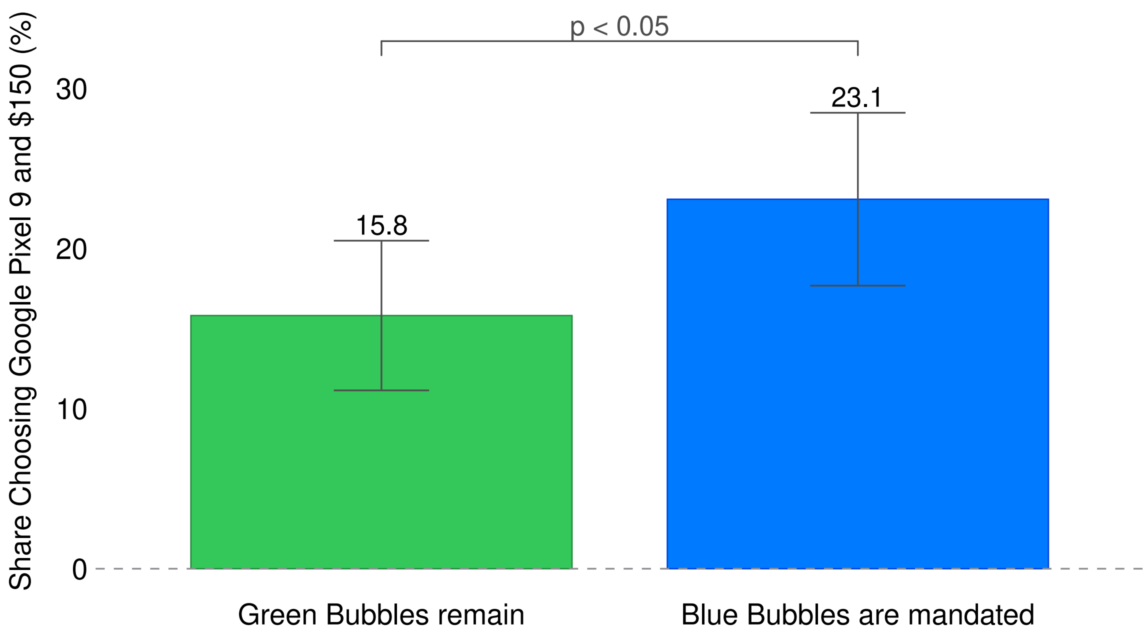
This section examines the potential mechanisms driving the changes in phone preferences identified in our experiment.

Social concerns. Building on Section 3.2, which found Android users are seen as less high attractive and well-earning, we analyze heterogeneous treatment effects based on relationship status. We find the strongest treatment effects for those who are single, where the social costs of being a non-user are likely higher due to dating market concerns. This furthermore constitutes suggestive evidence that demand effects are less likely to be an important driver of treatment effects. The full results can be found in Appendix Table A13.

Other equilibrium changes. One equilibrium mechanism through which the expectation of eliminating green bubbles might influence consumers' willingness to pay for iPhones over Android phones is the anticipated shift in user composition within social networks. To evaluate this, we first asked respondents about the current proportion of their friends who use iPhones versus Android devices. Respondents then

[30] We cannot fully rule out that respondents interpret the removal of green bubbles as a signal that other features might also be removed, and that this interpretation differs from the control group.

Figure 4: Percentage of Respondents Choosing the Google Pixel 9 Option over the iPhone 16 Option



Notes: This figure shows the percentage of respondents choosing the Google Pixel 9 and $150 over the iPhone 16, by treatment. Error bars are 95% confidence intervals.

estimated how these proportions would change one year into the future, conditional on their assigned scenario (i.e., the DOJ either banning or not banning green bubbles). This allowed us to quantify expected equilibrium shifts within each respondent's social network.

Our findings indicate that a majority (63%) expect no change in the composition of their network. Respondents in the blue bubbles scenario anticipate the proportion of friends using iPhones to decline by an additional 1.2 p.p. compared to those in the green bubbles scenario, a difference that is not statistically significant ($p = 0.150$). Relative to a baseline iPhone share of approximately 85%, that is a 1.4% change in the composition of their network. Additionally, there is only a weak correlation (-0.04) between expected network composition changes and choosing an Android device. Hence, network effects may play a limited role.

Another potential equilibrium change involves differences in perceived resale values of phones. Using the same question structure, we observe a relatively small correlation (-0.13) between the expected resale gap and selecting the Google Pixel 9 option. Furthermore, only 30% of these respondents anticipate reselling their phones if they win the lottery, and treatment effects are stronger among respondents who do not intend to resell, as detailed in Appendix Table A14. Participants in the blue bubbles scenario expect the iPhone's resale value to exceed the Pixel's by $20 less than those in the green bubbles scenario, although this difference lacks statistical significance at conventional levels ($p = 0.203$). This suggests that resale prices are also not the primary mechanism behind our treatment effects.

5.5 Robustness

Perceived credibility. Our design relies on respondents believing that the possible future scenarios could occur. To assess the perceived stakes, we ask them to rate how likely it is that their scenario will be implemented. As an example, in the green bubbles treatment we ask: "How likely do you believe it is that the DOJ lawsuit against Apple will succeed in making them pay significant fines but that green bubbles will remain in the coming months?". We find that people perceive the likelihood, on average, as 49% in the green bubbles treatment and 44% in the blue bubbles treatment, which suggests participants found the scenarios (similarly) credible. We also find stronger treatment effects among those who perceive their scenario as more likely, as shown in Appendix Table A14. This suggests that our estimates may understate the change in choice shares that a successful DOJ lawsuit removing green bubbles would produce.

Additional robustness. In Appendix E.4, we present additional robustness exercises. Specifically, we show that our results are robust to how we treat respondents who regret any of their choices and to different sample inclusion criteria.

Additional demand experiment. We conducted an additional pre-registered experiment that provides further evidence on how green bubbles increase demand for iPhones, using a different experimental design. In this experiment, we measure incentivized willingness to pay for an iPhone 16 Pro Max over a Samsung Galaxy S24 Ultra using a continuous BDM elicitation. Respondents are randomly assigned to either the green bubble or blue bubble treatment group. The green bubble group is informed that green bubbles will remain, while the blue bubble group learns that Android messages will appear as blue bubbles in the future—with the help of a recent technological advance that makes this change in color possible. Section H of our Online Appendix provides additional details on the design, data collection, and results.

Consistent with our main findings, respondents in the blue bubbles group have a \$43 lower WTP for the iPhone 16 Pro Max over the Samsung Galaxy S24 Ultra than our control group ($p < 0.05$). We observe an increase in the fraction of respondents preferring the Android over the iPhone, from 5.0% to 7.2%. While this represents a substantial 44% rise in Android's share, our study is not sufficiently powered to detect statistically significant effects on the extensive margin.

The intensive and extensive effect size reported in the robustness experiment should be interpreted with caution for at least four reasons: first, the Android phone used in the elicitation is not the usual outside option that iPhone users would consider as it is even more expensive than the iPhone. Second, we do not measure the first stage of expectations about text messages between Androids and iPhones appearing as blue on iMessage in the future. This likely means that we underestimate the effects of green bubbles on the demand for iPhones over Androids. Further, people may be uncertain over the relative quality of the phones as we do not provide information to benchmark quality. Indeed, we show in Section H.5 of our Online Appendix that there are widespread misperceptions over the quality of the Samsung Galaxy S24 Ultra compared to the iPhone 16 Pro Max. Finally, we do not screen for respondents who are looking to buy a new smartphone and thus, this sample is less informative about how green bubbles affects new purchasing decisions.

Despite these concerns, we view these results as evidence of robustness of our main treatment effect across demand elicitation methods (i.e., WTP versus binary choice) and brand of Android phone (i.e., the result is not specific to Google Pixels).

6 Non-User Externalities Across Product Features

Do non-user externalities extend to other product features or are they confined to green bubbles? To answer this, we survey 500 U.S. college students about nine product features spanning several markets, green bubbles among them.

6.1 Sample

Recruitment. Similar to our previous data collections, we recruited U.S. college students aged 18–23 through Prolific. The survey ran in July 2026.

Preregistration. This survey was preregistered on AsPredicted (#301847).[31]

Sample characteristics. Of the 670 respondents who completed the survey, 500 remain after our pre-registered exclusions for failing an attention check or a bot screen. The sample is 56% female with a mean age of 20.6; Appendix Table A16 reports full demographics and Appendix Table A17 lists the sample restrictions.

6.2 Design

Each respondent rates four of the nine product features, drawn at random, and answers four screens on each, plus one question per feature after the loop[32]. Appendix Table A18 gives the design and question wording for every feature, and Appendix G.6 the full instrument.

Preference over the product design. The first screen presents two labels, the firm's design and the counterfactual, in random order, and asks which the respondent would prefer.

[31] The preregistration includes the feature roster, the outcome measures, the sample size, and the exclusion criteria. For details, see `https://aspredicted.org/pm7jv4.pdf`.

[32] We record whether the respondent uses the product ("Do you own an iPhone?"), which we use to split responses.

Perceived quality. Two screens then ask how the counterfactual would change quality, one naming the product's user side and one an outside group, in random order.[33] Answers run on a five-point scale from "Strongly decrease" (-2) to "Strongly increase" ($+2$).

Mechanism. After the loop, one Yes/No question per feature asks whether the design choice makes the outside group feel lower status, excluded, or pressured to engage more often. We assign each feature one of these three channels, and each control feature's question mirrors the wording of one of the six features we study.

6.3 Product Features

We review product features that ex-ante plausibly impose non-user externalities through channels similar to green bubbles. They span several markets and vary in whether they impose such a cost and on whom. In particular, we can imagine non-user externalities operate along the extensive (cost falls on non user) and the intensive margin (cost falls on low-frequent users). We present evidence from both types:

1. *Strava's activity feed* (intensive): Strava posts workouts to friends' feeds by default (status quo), or keeps them private.
2. *Instagram's Stories* (intensive): Instagram removes Stories after 24 hours (status quo), or leaves them up for 48.
3. *Bumble's match expiration* (intensive): Bumble lets matches expire after 24 hours (status quo), or keeps them indefinitely.
4. *Nike's Air Jordan drops* (intensive): Nike rarely restocks sold-out colorways (status quo), or restocks them regularly.
5. *Apple's AirDrop* (extensive): Apple limits file transfers to its own devices (status quo), or extends them to Android phones.
6. *Apple's green bubbles* (extensive, benchmark): Apple marks messages from Android users in green (status quo), or shows every message in blue.

We further select three standard product features for similar companies with no non-user channel we can identify.

[33] For the five extensive-margin features the two screens name the product and a named competitor, for example: "In your view, if [the firm changed the design], how would the quality of iPhones (Android phones) change?" For the four intensive-margin features they name the product's frequent and its occasional users, for example: "... how would the quality of Instagram change for occasional Instagram users?"

1. *Google's Street View* (extensive): Google adds photos of real places to Maps (status quo), or does not.
2. *Spotify's Discover Weekly* (extensive): Spotify builds you a personalized weekly playlist (status quo), or does not.
3. *Snapchat's Memories* (extensive): Snapchat saves your snaps to a private archive (status quo), or does not.

6.4 Results

Preference over the product design. A majority of the respondents in our sample prefer the counterfactual (change of the product features) to the firm's current design for five of the six design choices (Figure 5, Panel (a)): 78% would have Strava keep workouts off friends' feeds by default, 64% would have Nike restock sold-out Air Jordan colorways, and 53% would have Bumble matches persist rather than lapse after a day. For AirDrop the share is 81%, and for green bubbles 52%. Instagram Stories is the exception at 21%: respondents would keep the 24-hour cycle rather than extend it to 48.[34] Between 1% and 9% prefer the counterfactual for the control features ruling out a mechanical effect. As in Section 3.2, the share is higher among respondents outside the product: 82% of respondents who do not use Strava would make workouts private, against 62% of its users ($p < 0.05$), and the same gap appears for green bubbles (78% against 47%, $p < 0.001$; Appendix Table A20).

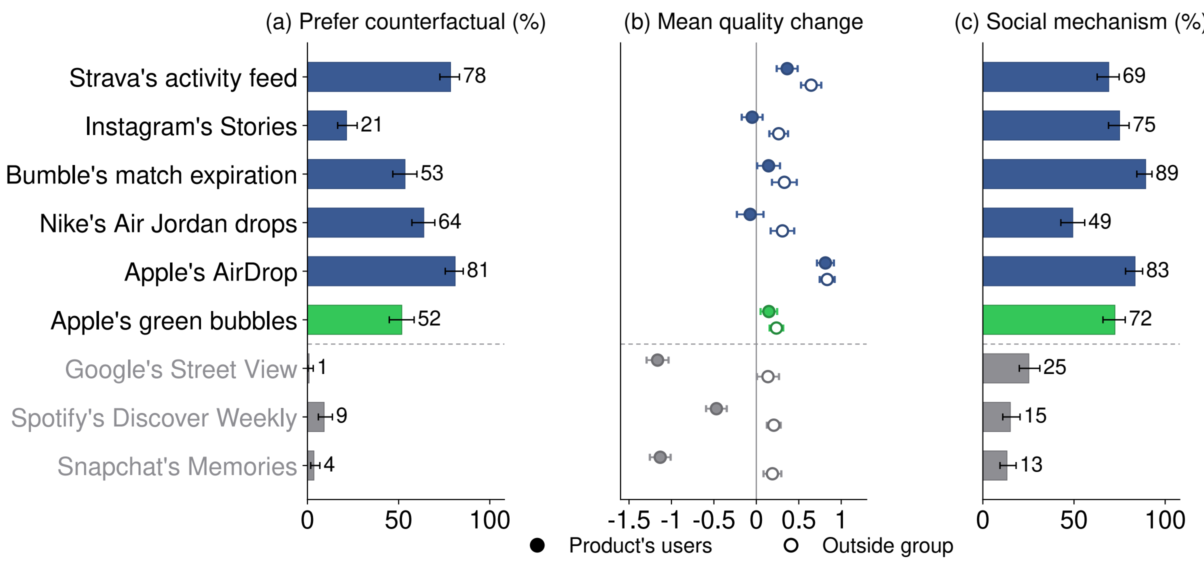
Perceived quality. Reversing the six design choices raises perceived quality for the outside group, and lowers it for the product's own users by no more than -0.07. Mean perceived quality for the outside group is between $+0.24$ and $+0.83$, and for the product's users between -0.07 and $+0.81$ (Figure 5, Panel (b)). Reversing a control feature instead lowers quality for the product's own users, by -0.47 for Spotify's Discover Weekly and -1.16 for Google's Street View. This asymmetry—a quality gain outside the product that its own users do not pay for—is the signature pattern identified for green bubbles in Section 3.2.[35]

[34]Instagram is the most widely used product in our sample (94%; Appendix Table A19). A longer cycle gives occasional users more time to see what was posted and leaves frequent posters exposed for longer.

[35]Netting out individual scale use with a respondent fixed effect leaves the user-side ordering unchanged (Appendix Table A21). Appendix F.4 reports the quality results in full.

Mechanism Respondents attribute a social channel to each of the six design choices. On pressure to engage, 89% state that Bumble's 24-hour match expiry pressures occasional users to check the app more often, 75% say the same of Instagram Stories and 69% of Strava's default-public feed. On status, 49% state that limited Air Jordan drops lower the status of occasional buyers, and 72% that green bubbles lower the status of Android users. On exclusion, 83% state that confining AirDrop to Apple devices leaves Android users excluded. Between 13% and 25% attribute the parallel channel to the control features (Figure 5, Panel (c)).[36]

Figure 5: Non-User Externalities across Product Features



Notes: Each row names a design choice a firm has made; the three control features sit below the rule. Panel (a) displays the share of respondents preferring the counterfactual state of the world in which the firm has chosen otherwise: workouts private by default; Stories visible for 48 hours; matches do not expire; sold-out colorways regularly restocked; AirDrop also transfers files to Android phones; all messages appear in blue; and, for the control features, Google Maps without Street View, Spotify without the weekly playlist, and Snapchat without the archive. Panel (b) displays the mean perceived quality change under that counterfactual on a five-point scale from "Strongly decrease" (-2) to "Strongly increase" ($+2$), with filled markers for the product's users and open markers for the outside group. Panel (c) displays the share answering Yes to the mechanism question, which asks whether the design choice makes the outside group feel lower status, excluded, or pressed to engage more often. Error bars represent 95% intervals in Panels (a) and (c) and 95% confidence intervals in Panel (b). $N = 500$ respondents contributing 2000 ratings; per-feature sample sizes are in Appendix Table A19.

Across the six design choices, the pattern is the one Section 2 identifies as welfare-reducing: the counterfactual draws majority support for five of the six, costs the

[36] Spotify's Discover Weekly carries the status wording, and Google's Street View and Snapchat's Memories the exclusion wording (Appendix Table A18).

product's own users little, and is attributed a social cost outside the product. The cost is not a by-product of how a market coordinates but the result of a design a firm chose and could reverse. Appendix F reports the full results and robustness checks.

7 Conclusion

In this paper, we provide evidence that companies can influence demand for their products not only through increasing user utility but also through creating negative non-user externalities. Our model shows why the distinction matters: the two routes to higher demand look alike in prices and quantities, yet only the second leaves both users and non-users worse off. Using the case of "green bubbles" on iPhones, we provide survey and experimental evidence that a simple design feature stigmatizes Android owners, lowers their perceived social status, and thereby shifts demand toward iPhones. iPhone users require substantial compensation to have their messages appear as green bubbles, and removing them substantially increases the relative attractiveness of Android devices among U.S. college students.

Our findings inform the ongoing DOJ lawsuit against Apple concerning alleged anticompetitive practices, particularly those involving iMessage. Despite Apple's adoption of RCS in iOS 18 to address certain compatibility issues, our evidence indicates that removing green bubbles would lower negative non-user externalities among U.S. college students. This case exemplifies how dominant firms may leverage social concerns to entrench their market power, reducing the attractiveness of rival products without necessarily improving the core functionality of their own.

A promising direction for future research is to explore—both theoretically and empirically—the interplay between pre-existing market power and the strategic generation of non-user externalities. A key open question is whether, and to what extent, firms with greater market power are more effective in creating non-user externalities. This issue has significant welfare implications, as the creation of non-user externalities is particularly detrimental if it reinforces the dominance of the most powerful firms in the market. The increase in market power can lead to less innovation and fewer incentives to develop user-centric improvements, resembling exploitative innovation (Heidhues et al., 2016).[37] However, if companies with low market power and

[37] As opposed to exploitative innovation, the creation of non-user externalities we study affects users but also has negative externalities on non-users. Additionally, hidden fees can be targeted through policies of consumer protection and disclosure rules, but reducing stigma embedded in design and social norms likely requires very different instruments.

small market shares create non-user externalities, the overall welfare effects could be ambiguous, as the welfare benefits from increased competition might outweigh any direct negative effects from the rise in non-user externalities.

As our cross-market evidence demonstrates, these dynamics extend beyond the smartphone market. Future research could investigate the broader effects of non-user externalities across industries and over time. Such insights could provide valuable guidance for policymakers aiming to regulate and mitigate anti-competitive behaviors by firms.

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Appendix:

A Mathematical Appendix

A.1 Main Proofs

In what follows, let $\mu_j := p_j - c$ denote the markup of firm j and $\pi_j(p_j, p_{-j})$ denote its profit function.

Proof of Lemma 1. As it is well known, the log-concavity Assumption 1 ensures that the second-order conditions of each firm hold. To see why, note that the log-concavity of f implies the log-concavity of $Q = 1 - F(p_A - p_B - g)$ and $1 - Q = F(p_A - p_B - g)$. In turn, the log-concavity of Q implies that $Q'^2 - Q''Q > 0$ and the log-concavity of $1 - Q$ implies that $Q'^2 + Q''(1 - Q) > 0$.

Focusing on firm A, we take the second derivative of the profit function to verify that the second-order conditions hold. Note that $\partial^2 \pi_A / \partial p_A^2 = Q''\mu_A + 2Q'$. After substituting the value of μ_A from the first-order condition (FOC), we get $-Q''Q/Q' + 2Q'$. Multiplying by $-Q'$ gives $Q''Q - 2Q'^2 < Q''Q - Q'^2$, which is negative by log-concavity. A similar procedure shows that firm B's second-order conditions hold.

Let $P_j(p_{-j})$ denote the best response function of j. Note that $P_j' \in (0, 1)$. To see why, focus on firm A and use the implicit function theorem (applied to the firm's FOC) to get: $P_A' = \frac{Q'^2 - Q''Q}{2Q'^2 - Q''Q}$. A similar procedure applies to B's best response. Finally, note that $P_j(p_{-j}) > c > 0$. This condition and the bounds on the derivative of P_j ensure that the best responses of both firms cross at prices above marginal cost and that they do so only once. ∎

Proof of Proposition 1. Consider a marginal increase in g, dg. Applying the implicit function theorem over the FOCs of A and B, we get:

$$\frac{dp_A}{dg} = \frac{Q'^2 - QQ''}{Q''(1 - 2Q) + 3Q'^2}$$
$$\frac{dp_B}{dg} = -\frac{Q'^2 + Q''(1 - Q)}{Q''(1 - 2Q) + 3Q'^2}$$

Note that the denominator of both equations is positive, since it equals the sum of three terms: $Q''(1 - Q) + Q'^2$, plus $Q'^2 - Q''Q$ (both positive due to Assumption 1), and Q'^2. The numerators in both expressions are positive again due to log-concavity, implying that $dp_A/dg > 0$ and $dp_B/dg < 0$. Hence, firm A's equilibrium markup increases and firm B's equilibrium markup decreases in response to dg. Moreover, note that the numerator in both cases is lower than the denominator, implying that $dp_A/dg < 1$ and $-dp_B/dg < 1$. Additionally, $(dp_A - dp_B)/dg < 1$, which implies that demand for A, $Q(p_A - p_B - g)$, increases, and demand for B decreases. ■

Proof of Proposition 2. Let $\mathbf{u} = (u_A, u_B)$. Consumer welfare is given by:

$$W(g_u, g_n) := \underbrace{\int_{\mathbf{u}:\, u_A - p_A \geq u_B - p_B - g} (u_A + g_u - p_A) f(\mathbf{u}) d\mathbf{u}}_{\text{Welfare of } A\text{'s consumers}} + \underbrace{\int_{\mathbf{u}:\, u_A - p_A < u_B - p_B - g} (u_B - g_n - p_B) f(\mathbf{u}) d\mathbf{u}}_{\text{Welfare of } B\text{'s consumers}}.$$

Differentiate W:

$$dW = Q(dg_u - dp_A) - (1 - Q)(dg_n + dp_B).$$

Consider first the case when A only creates non-user disutility; that is, when $dg = dg_n$ and $dg_u = 0$. In this case, consumers of A are unambiguously worse off since they experience an increase in p_A and no offsetting increase in user utility. Moreover, consumers of B are also worse off since the decrease in price p_B is not enough to offset the increase in g, so $-dg - dp_B < 0$. Thus, $dW < 0$.

Consider now the case when A only creates user utility; that is, when $dg = dg_u$ and $dg_n = 0$. In this case, consumers of A are unambiguously better off since they experience an increase in g which is large enough to offset the increase in p_A, so $dg - dp_A > 0$. Moreover, consumers of B are also better off since they experience a decrease in p_B, without a decrease in their non-user utility. Hence, $dW > 0$. ■

Supplemental Appendix: For online publication

Contents

A Supplemental Mathematical Appendix

A.2 Microfoundation

This subsection presents a duopoly model where firms compete in prices and where they can influence the stigma associated with consuming their products, effectively creating non-user disutility for some consumers and user utility for others. The purpose of the section is to microfound the model presented in Section 2, endogenizing two features that were exogenous in that model: the non-user utility term g and the fact that only one company could generate non-user disutility. We will show that only the company that is relatively more associated with "high types" will choose to generate non-user disutility.

Setup. The setup is similar to the model in Section 2, but with a continuum of consumers of two types: "high," H, (of mass γ) and "low," L, (of mass $1-\gamma$). Consumers must choose which of the two products they purchase. The total utility that they get from a product comes from two channels: 1) a direct utility from consuming it and 2) a social image concern.

Concretely, the value that i gets from purchasing product $j \in \{A, B\}$ is:

$$\underbrace{u_j^i}_{\text{Direct utility}} + \underbrace{S(q_j^H, q_j^L)(\lambda_A + \lambda_B)}_{\text{Social image}} - p_j,$$

where q_j^θ is the demand of type $\theta \in \{H, L\}$ for product j and $\mathbf{q} = (q_A^H, q_A^L)$ is the vector of demands for product A.[38] We index consumers by the difference in their

[38]Note that $q_A^H + q_B^H = \gamma$ and $q_A^L + q_B^L = 1-\gamma$, so it is enough to keep track of the demand for product A, without loss of generality.

direct utility from product A vs. B, $u^i := u^i_A - u^i_B$. We assume that u^i is distributed according to a strictly increasing smooth distribution F^θ with bounded density f^θ with full support for each type.

The social image term $S(q^H_j, q^L_j)(\lambda_A + \lambda_B)$ follows the framework in Bursztyn and Jensen (2017) extended from Bénabou and Tirole (2006). The function S represents how other individuals perceive i given i's purchase decision. This function is positive or negative whenever there are positive or negative image concerns, respectively. To fix ideas, we assume the following functional form, although the main results hold with more general functional forms:

$$S(q^H_j, q^L_j) := (1-\gamma)q^H_j - \gamma q^L_j$$

This function takes a value of zero—the social image concern disappears—when the fraction of H purchasing the product equals the fraction of H in the population (γ). That is, when the posterior likelihood of being a high type given purchase of j is equal to the prior—when phone choice is uninformative of individual type. Additionally, note that S is increasing in q^H_j and decreasing in q^L_j, to capture that i's image improves as more H individuals purchase the same product and worsens as more L individuals do.

The non-negative parameters λ_A, λ_B correspond to the importance or salience of the social image concern and are determined by platforms' product choices. For example, firm A can marginally increase the saliency of social image relative to an initial baseline of zero—say, by allowing its customers to distinguish which phone other customers have. In this case, A customers face social image concerns vis-à-vis other A customers equal to $S(q^H_A, q^L_A)\lambda_A$, and B customers face $S(q^H_B, q^L_B)\lambda_A$ vis-à-vis A customers. We have assumed, for simplicity, that firms impose the same salience of the social image concerns on both users and non-users, thereby creating user and non-user utility simultaneously. This assumption can be relaxed by allowing these parameters and the function S to differ between users and non-users, but the main implications of the model remain unchanged. Note also that our assumptions imply that only one phone—the one relatively more associated with H customers—will have positive image concerns. Therefore, by increasing saliency of social image, the company that sells that phone will increase user utility and decrease non-user utility, while the other company will do the reverse.

Timing. The timing of the model is as follows. First, firms choose simultaneously their product design: whether to costlessly and marginally increase the salience parameter λ_j. After this decision, both firms compete in prices.

Equilibrium. Let $Q_j^{c,\theta}\left(p_j^D - S^D(q_j^H, q_j^L)(\lambda_A + \lambda_B)\right)$ denote the aggregate demand of type θ for product j, conditional on (expected) quantities, where $p_j^D := p_j - p_{-j}$ is the price difference and $S^D(q_j^H, q_j^L) := S(q_j^H, q_j^L) - S(\gamma - q_j^H, (1-\gamma) - q_j^L)$ is the difference in social image concerns between products. We impose, for tractability, an assumption that ensures that network effects are not too strong.

Assumption 2. *The salience of the social image concerns is not too high:* $\lambda_j \in \{0, d\lambda_j\}$*, where* $d\lambda_j \to 0$.

In words, we restrict attention to the case where social image concerns are arbitrarily small, so that firms' product design choices can be interpreted as an infinitesimal perturbation around the benchmark without image concerns. This allows us to abstract from higher-order effects that complicate the analysis but do not qualitatively change the mechanisms we highlight.

Given Assumption 2, the next lemma shows that downward-sloping demand functions exist given firm product design choices λ. Without loss of generality, we focus on the demand for A since $Q_B^H = \gamma - Q_A^H$ and $Q_B^L = 1 - \gamma - Q_A^L$.

Lemma 2. *Fix* $\lambda := \lambda_A + \lambda_B$ *and the price difference* p_A^D*. Under Assumption 2, there exist downward-sloping demand curves* $Q_A^\theta(p_A^D, \lambda)$ *which solve the following fixed-point problem:*

$$q_A^\theta = Q_A^{c,\theta}\left(p_A^D - S^D(q_A^H, q_A^L)(\lambda_A + \lambda_B)\right) \tag{2}$$

Proof. Define the mapping $\Phi(q_A^H, q_A^L) = (Q_A^{c,H}, Q_A^{c,L})$. We will show that Φ is a contraction on a compact, convex set ($[0,\gamma]\times[0,1-\gamma]$) and apply the Banach Fixed-Point Theorem.

Consider two points, (q_A^H, q_A^L) and $(q_A'^H, q_A'^L)$. By the mean-value theorem,

$$\left|\Phi^\theta(q_A^H, q_A^L) - \Phi^\theta(q_A'^H, q_A'^L)\right| \le \max_x f^\theta(x) \cdot \left|S^D(q_A^H, q_A^L) - S^D(q_A'^H, q_A'^L)\right| \cdot (\lambda_A + \lambda_B).$$

Since S is continuously differentiable,[39]

$$\left|S^D(q_A^H, q_A^L) - S^D(q_A'^H, q_A'^L)\right| \;\leq\; \|\nabla S^D\|_\infty \left(\left|q_A^H - q_A'^H\right| + \left|q_A^L - q_A'^L\right|\right).$$

Hence,

$$\left|\Phi^\theta(q_A^H,\, q_A^L) - \Phi^\theta(q_A'^H,\, q_A'^L)\right| \;\leq\; \|f^\theta\|_\infty \cdot \|\nabla S^D\|_\infty \cdot (\lambda_A + \lambda_B) \cdot \left(\left|q_A^H - q_A'^H\right| + \left|q_A^L - q_A'^L\right|\right).$$

By Assumption 2, and since $\|\nabla S^D\|_\infty \leq 2$,[40] and f^θ is bounded, $\|f^\theta\|_\infty \cdot \|\nabla S^D\|_\infty \cdot (\lambda_A + \lambda_B) < 1$, so Φ is a contraction. To see why the resulting demands $Q_A^\theta(p_A^D, \lambda)$ are downward-sloping, apply the Implicit Function Theorem on Equation (2) to get:

$$\frac{\partial Q_A^\theta}{\partial p_A^D} = \frac{Q_A^{c,\theta'}}{1 + 2(\lambda_A + \lambda_B)\left[(1-\gamma)Q_A^{c,H'} - \gamma Q_A^{c,L'}\right]}. \tag{3}$$

The numerator of this expression is negative and the denominator is positive (and close to one) by Assumption 2. ■

We now impose a set of assumptions that will ensure that demands are log-concave.

Assumption 3. *The densities f^θ are strictly log-concave.*

Assumption 4. *Demands have bounded curvatures:*

$$f^{H'}(1 - F^L) + f^{L'}(1 - F^H) \geq \max\left\{f^{H'} + f^{L'}, 0\right\} - 2f^H f^L$$

Lemma 3. *Under Assumptions 2 to 4, the demand curve $Q_A(p_A - p_B, \lambda) := Q_A^H(p_A - p_B, \lambda) + Q_A^L(p_A - p_B, \lambda)$ is log-concave in p_A and the demand curve $Q_B := 1 - Q_A$ is log-concave in p_B.*

Proof. We begin by showing that Q_A is log-concave; that is, that $Q_A'' Q_A \leq {Q_A'}^2$, where $Q_A' := \frac{\partial Q_A}{\partial p_A}$ and Q_A'' is defined accordingly. Let $D_A := (1-\gamma)Q_A^{c,H'} - \gamma Q_A^{c,L'}$ and note that ${Q_A^\theta}' = Q_A^{c,\theta'}/(1 + 2\lambda D_A)$ from Equation (3) (where $1 + 2\lambda D_A$ is the denominator, which is positive as argued above). Similarly, let $E_A := (1-\gamma)Q_A^{c,H''} - \gamma Q_A^{c,L''}$. Differentiating ${Q_A^\theta}'$ we get: ${Q_A^\theta}'' = \frac{Q_A^{c,\theta''}}{(1+2\lambda D_A)^2} - 2\lambda \frac{Q_A^{c,\theta'} E_A}{(1+2\lambda D_A)^3}$. Then, the inequality

[39] Here, $\|\cdot\|_\infty$ denotes the supremum norm.

[40] This is by the definition of S, which guarantees that $|S| \leq 1$.

$Q''_A Q_A \leq {Q'_A}^2$ can be written as:

$$\left[\frac{Q_A^{c,H''} + Q_A^{c,L''}}{(1+2\lambda D_A)^2} - 2\lambda E_A \frac{Q_A^{c,H'} + Q_A^{c,L'}}{(1+2\lambda D_A)^3}\right]\left(Q_A^{c,H} + Q_A^{c,L}\right) \leq \frac{Q_A^{c,H'^2} + Q_A^{c,L'^2} + 2Q_A^{c,H'}Q_A^{c,L'}}{(1+2\lambda D_A)^2}$$

We can rewrite this expression as:

$$\begin{aligned}&\left[\left(Q_A^{c,H''}Q_A^{c,H} - Q_A^{c,H'^2}\right) + \left(Q_A^{c,L''}Q_A^{c,L} - Q_A^{c,L'^2}\right)\right] \\ &+ \left[Q_A^{c,H''}Q_A^{c,L} + Q_A^{c,L''}Q_A^{c,H} - 2Q_A^{c,H'}Q_A^{c,L'}\right] \leq 2\lambda E_A \frac{Q_A^{c,H'} + Q_A^{c,L'}}{(1+2\lambda D_A)} Q_A.\end{aligned} \tag{4}$$

The first row in Equation (4) is negative because of the log-concavity of $Q_A^{c,\theta}$ inherited from f^θ (Assumption 3). The left-hand side of the second row of Equation (4) can be rewritten as: $-f^{H'}(1-F^L) - f^{L'}(1-F^H) - 2f^H f^L$. This expression is negative by Assumption 4. Lastly, the right-hand side of Equation (4) approaches 0 by Assumption 2. Thus, we confirm that the inequality holds.

Next, we repeat a similar procedure to show that $Q''_B Q_B \leq {Q'_B}^2$, where $Q'_B := \frac{\partial Q_B}{\partial p_B}$ and Q''_B is defined accordingly. We can rewrite the relevant inequality as:

$$\begin{aligned}&\left[\left(Q_B^{c,H''}Q_B^{c,H} - Q_B^{c,H'^2}\right) + \left(Q_B^{c,L''}Q_B^{c,L} - Q_B^{c,L'^2}\right)\right] \\ &+ \left[Q_B^{c,H''}Q_B^{c,L} + Q_B^{c,L''}Q_B^{c,H} - 2Q_B^{c,H'}Q_B^{c,L'}\right] \leq 2\lambda E_B \frac{Q_B^{c,H'} + Q_B^{c,L'}}{(1+2\lambda D_B)} Q_B.\end{aligned} \tag{5}$$

As above, the first row in Equation (5) is negative because of the log-concavity of $Q_A^{c,\theta}$ inherited from f^θ and the right-hand side of the inequality approaches 0 by Assumption 2. Given that $Q_B = 1 - Q_A$, we can rewrite the left-hand side of the second row of Equation (5) as:

$$Q_A^{c,H''}Q_A^{c,L} + Q_A^{c,L''}Q_A^{c,H} - 2Q_A^{c,H'}Q_A^{c,L'} - Q_A^{c,H''} - Q_A^{c,L''}.$$

This expression is negative by Assumption 4.

■

Now, consider the subgame that follows firms' product design choices λ_j.

Lemma 4. *Under Assumptions 2 to 4, there exists a unique Nash equilibrium in the subgame that follows firms' product design choices λ_j. Let $p_j(\lambda)$ denote the equilibrium* *prices in that subgame.*

Proof. The proof follows from applying Lemma 3 to show that demands are log-concave, and following a similar procedure as in Lemma 1. ■

In the following proposition, we characterize the equilibria of this game. We will show that, in the more interesting case when firms are slightly differentiated, only one firm will choose to make social image concerns salient in equilibrium. In this case, the company that chooses to make social image concerns salient in equilibrium is the one that is relatively more associated with the high types in the absence of social image concerns.

Before presenting the proposition, we introduce some useful notation. Let $p_A^D(0)$ denote the equilibrium price difference between product A and B in the subgame when $\lambda_j = 0$ (which exists and is unique by Lemma 4). Let $Q_A^{\theta,0} := Q_A^\theta(p_A^D(0), 0)$ denote the equilibrium demand for A by type θ in that subgame, and $S^0 := S^D(Q_A^{H,0}, Q_A^{L,0})$ denote the equilibrium difference in social image terms between A and B. Note that $S^0 > 0$ ($S^0 < 0$) if A (B) is relatively more associated with high types in that subgame, while $S^0 = 0$ if both firms have the same ratio of high types and low types.

Proposition 3. *Under Assumptions 2 to 4, if $S^0 \neq 0$, there exists a unique subgame perfect equilibrium in this game where only one firm—the one relatively more associated with high types—chooses to make the social image concerns salient; firm A if $S^0 > 0$ and B otherwise. If $S^0 = 0$, both companies are indifferent between making the social image concerns salient or not, so there are multiple equilibria.*

Proof. The key to this proof is to notice that, when $\lambda \approx 0$, we can write:

$$q_A = Q(p_A - p_B - g), \tag{6}$$

where $g := \lambda S^0$. Suppose without loss of generality that $S^0 > 0$. Consider the profit function of firm A conditional on product choices λ (and, hence, g):

$$\pi_A(\lambda) := [p_A(\lambda) - c]\, Q(p_A - p_B - g(\lambda)).$$

Differentiate with respect to λ:

$$\pi'_A := p'_A\, [Q + (p_A - c)Q'] + (p_A - c)\, [-Q'g' - Q'p'_B] = (p_A - c)\, |Q'|\, (g' + p'_B)\,,$$

where we have used that the term $Q + (p_A - c)\frac{\partial Q}{\partial p_A}$ is zero by A's FOC in the final subgame. This FOC also implies that $p_A - c > 0$. Thus, the sign of π'_A depends on the sign of $g' + p'_B$. Note that $g' = S^0$ by the definition of g. Since $p'_B = \frac{dp_B}{dg}\frac{dg}{d\lambda} = \frac{dp_B}{dg}S^0$, we have that $g' + p'_B = S^0(1 + \frac{dp_B}{dg})$. We can then use the same procedure from the proof of Proposition 1 to show that $1 + \frac{dp_B}{dg} > 0$, which implies that $\pi'_A > 0$.

Following a similar argument, $\pi'_B = (p_B - c)\,|Q'|\,S^0(\frac{dp_A}{dg} - 1)$. From the proof of Proposition 1, $\frac{dp_A}{dg} - 1 < 0$. Therefore, when $S^0 > 0$, $\pi'_A > 0$ and $\pi'_B < 0$. ■

Thus, we have microfounded that 1) the non-user disutility term of Section 2 can arise from a model where companies choose to make social image concerns salient, and 2) in such a model, only one company chooses to make these image concerns salient in equilibrium: the company that is relatively more associated with high types.

B Institutional Background

This appendix provides additional detail on the smartphone market and regulatory environment. We describe global and U.S. market structure, cross-country variation in messaging platforms, and the DOJ lawsuit and EU Digital Markets Act.

B.1 Market Background

The global market for smartphones. The global smartphone market is substantial and growing, valued at \$566 billion (Precedence Research, 2024) with 1.24 billion smartphone shipments expected to occur in 2024 (International Data Corporation, 2024). The market is characterized by a duopoly of smartphone operating systems: Android and iOS. Globally, Android and iOS devices represent 79% and 17% of the market share of users, respectively (Counterpoint Research, 2025).[41] Android market share is comprised of many differentiated brands, led primarily by Samsung (International Data Corporation, 2024).

The U.S. smartphone market. The U.S. smartphone market is valued at \$61 billion (Market Research Future, 2024). High smartphone penetration rates and the prevalence of iOS devices, which are typically much pricier than Androids, are the

[41]Less than 1% of smartphones use a different operating system, comprised of many smaller systems.

primary drivers of this high valuation (Designveloper, 2024). In the U.S., the share of iOS devices is more than twice the global average at 50% market share (Counterpoint Research, 2025)[42]. Apple holds an overall market share of 56% (StatCounter, 2024), rising to 68% among 18–29 year olds (Statista, 2024) and 87% among teenagers (Axios, 2021). Android sales are mostly driven by established leader Samsung (StatCounter, 2024) and increasingly popular Google devices (Schoon, 2024).

Cross-country variation in messaging platforms. There are drastic differences in smartphone operating system ownership across countries, even at comparable income levels. The most striking example of this pattern is the difference between the U.S. and Canada compared to Europe. Table A1 below illustrates this by showing iPhone market share and WhatsApp penetration levels in European and North American countries, highlighting their negative correlation. The statistics are consistent with iPhone users disproportionately using iMessage and SMS/MMS texting to communicate with other smartphones, as opposed to other third-party messaging platforms. Further, it also suggests that the U.S. and Canada's smartphone messaging norms are substantially different from those of the rest of Europe.

Switzerland sits at 55.92% iPhone market share with 95.9% using WhatsApp to message. The U.S., at comparable iPhone rates and GDP, has a WhatsApp share of just 41%. A likely explanation is that WhatsApp became much more prevalent than text messaging in Europe because the cost of text messaging was historically very high in European countries, in contrast to the unlimited texting plans that were common in the U.S. (Zhukova, 2022). Further, there is a greater need for cross-border communication in Europe, which may have pushed people to find alternative options to expensive international messaging fees.

B.2 DOJ Lawsuit and Regulatory Details

B.2.1 Department of Justice Lawsuit

In March 2024, the Department of Justice (DOJ), along with 16 other state and district attorneys general, filed a case against Apple for violating antitrust laws. The lawsuit argues that Apple has created a monopoly in the smartphone market,

[42] Estimates vary across sources and methodologies. We report Counterpoint's market-share figures here.

Appendix Table A1: WhatsApp and iPhone Market Shares by Country as of 2022

Country	iPhone Market Share (%)	WhatsApp Market Share (%)
Spain	21.40	92.20
Russia	26.16	83.70
Italy	29.31	97.00
Germany	37.67	95.50
Austria	39.49	94.40
Netherlands	40.31	92.90
United Kingdom	51.63	71.30
Switzerland	55.92	95.90
United States	56.74	41.20
Canada	57.84	42.40

Notes: This table presents iPhone and WhatsApp market shares in 2022 for selected European countries, as well as Canada and the U.S. iPhone market data are sourced from World Population Review (2024), and WhatsApp market data are sourced from Statista (2023).

in violation of Section 2 of the Sherman Act, through various practices which stifle competition and innovation, while enabling the company to extract higher prices from its customer base.

Key allegations include blocking innovative super apps, which combine smaller apps and services into a singular application and could hence reduce reliance on the iOS App Store, and restricting cloud streaming services like Xbox Cloud Gaming and Google Stadia, which allow high-quality gaming on remote servers rather than powerful hardware. Other examples cited are limiting third-party apps' functionality to position Apple's services like iMessage and its digital wallet as superior, which increases the switching cost for consumers.

Another claim is that Apple has worsened the quality of cross-messaging features. Messages from non-iPhone users are displayed as green bubbles instead of blue, are not encrypted, and do not have typing or editing indicators. This could lead to perceived lower quality of non-iPhones and social stigma towards non-iPhone users, especially among teenagers.

B.2.2 European Union's Digital Markets Act

The Digital Markets Act (DMA) is a piece of legislation by the European Union intended to regulate the market power of digital platforms that the act classifies as "gatekeepers". The main objectives of the DMA are to promote fair competition, allow smaller companies a level playing field to innovate, and provide consumers with greater choice of digital services.

Apple is classified as a gatekeeper under the DMA as it meets all three criteria. Firstly, it has "significant impact on the internal market", with an annual turnover above EUR 7.5 billion and an average market capitalization exceeding EUR 75 billion. Secondly, it provides a gateway between businesses and end users, through the iOS App Store which allows developers to access a large customer base and exceeds the DMA's thresholds for monthly active end users and yearly active business users. Lastly, Apple's core platform services, including the App Store and iOS, have sustained a strong economic position over time, which qualifies the company as having an "entrenched and durable position".

C Green Bubble Stigma

This appendix presents additional evidence on the green bubble stigma from the dedicated mechanism survey of 476 U.S. college students. We describe the sample, the open-text classification methodology, and additional results on social perceptions, quality misperceptions, and the perceived stakes of the incentives.

C.1 Sample Characteristics

Table A2 reports demographic summary statistics for the mechanism survey sample.

C.2 Open-Text Classification

Following Bursztyn et al. (2025a) and best practices outlined in Haaland et al. (2023) and Haaland et al. (2025), we use open-ended questions to provide unstructured evidence on the existence of and mechanisms behind the green bubble stigma. The first question is asked at the start of the survey to avoid priming. The remaining three are asked after informing participants about green bubbles and existing compatibility issues:

- "When you think of someone who owns an Android instead of an iPhone, what comes to mind?"

Appendix Table A2: Summary Statistics for Mechanism Survey Sample

Variable	Mean
Panel A: Demographics	
Gender (Ind. for Female)	0.55
Age	20.39
Relationship Status (Ind. for Single)	0.63
Panel B: Operating System	
iOS (Ind. for Yes)	0.84
MacBook (Ind. for Yes)	0.51
Observations	476

Notes: This table summarizes demographic statistics for the mechanism survey sample, restricted to respondents who passed all attention checks and bot detection protocols.

- "Why do you think messages sent from iPhones to Androids appear as green bubbles on iPhones?"

- A binary question "Imagine a scenario where after the release of the iOS 18 update, an additional messaging feature could eliminate green bubbles by making all messages, from both iPhones and Androids, appear as blue bubbles on all iPhones. Would you want all iPhone and Android users, including yourself, to have this additional messaging feature?" and independent of the answer "Please explain why in full sentences."

- A binary question "Do you think that there is a social stigma against Android users whose text messages appear as green bubbles on iPhones?" and independent of the answer "Please explain in full sentences why you think that."

Hand-coding. We classify responses into seven non-mutually exclusive categories. Tables A3–A6 report the coding scheme used for each of the four open-ended questions, including category definitions and example responses. Two research assistants independently classified each response, with disagreements reconciled through discussion.

Appendix Table A3: Hand-coding scheme: stereotypes about Android users

Category	Definition	Example response
Stigma and Social Status	Responses that reflect perceptions of social judgment, peer pressure, or a perceived lower or higher social status or income associated with owning an Android. These responses may also describe Android users' perceived hatred for Apple, or annoyance at compatibility issues between Android phones and iPhones.	"I kind of gives me the ick when I see someone not using an iPhone since my whole life iPhone was always the top of the line and if you didn't use one you were below everyone else who did." *or* "I recently re-entered the dating scene, and I was messaging a girl on instagram before she asked for my number. Upon giving her my number and texting her a bit, she made a comment about my messages "being green" on her iPhone. This isn't the first time someone has mentioned my android phone in a sort of derogatory, disparaging tone. I own an Android because it's cheaper and it does what I need it to do. I can't count the number of times someone has asked me "Why don't you have an iPhone?"."
Demographic Perceptions	Responses that discuss at least one of age, profession, income, family, education, geographic region / nationality, or ethnicity, without implying personality judgments nor mentioning stigmatization.	"I feel like Android users are more old people." *or* "An average person wealthier maybe with some nicer clothes."
Neutral or Indifference	Responses that show indifference, neutrality, or no specific judgment regarding the use of Android over iPhone.	"I don't have much an opinion on it. I just see it as they have a phone." *or* "Nothing really comes to mind, everybody has their own phone brand preferences."

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Appendix Table A3: Hand-coding scheme: stereotypes about Android users (continued)

Category	Definition	Example response
Financial and Practical Considerations	Responses that emphasize cost, affordability, or practical reasons for choosing an Android over an iPhone.	"When I think of someone who owns an Android instead of an iPhone, I often imagine they might value flexibility and customization in their device" *or* "Someone who's trying to save more money. Someone is trying to get more value out of what they buy. Someone who needs something more versataile and customizable for their ambition."
Technical Differences	Responses that focus on the technical features, functionality, or quality of Android devices compared to iPhones.	"Lower functionally when it comes to iMessages. Namely, they won't be able to see the same emojis that I do and they will not have the same group chat functionality. In addition, no FaceTime" *or* "Some features will not be able to be shared between people if one has an iPhone and the other has android. Newer Android phones seem to typically have a better camera than iPhones."
Green Bubbles	Responses that specifically mention the green bubble color that appears on iPhones when messaging Androids.	"Someone who texts with green text bubbles."

Continued on next page

Appendix Table A3: Hand-coding scheme: stereotypes about Android users (continued)

Category	Definition	Example response
Personality Traits	Responses that attribute positive personality characteristics, behaviors, or values to Android users, and that do not mention stigmatization. "Personality Traits" are internal qualities that reflect someone's character. Note that responses that are explicitly about negative personality traits of Android users should be coded as "Social Status and Stigma" instead.	"I perceive them as caring less about social pressure, instead focusing on personal preference and specific functionality." *or* "I believe a person who owns an Android would be more tech savvy."

Notes: The table provides an overview of the hand-coding scheme used to categorize open-ended responses to the question, "When you think of someone who owns an Android instead of an iPhone, what comes to mind?" This question was asked without any priming and was posed to all participants, regardless of their operating system.

Appendix Table A4: Hand-coding scheme: perceived reasons for green bubbles on iPhones when messaging Androids

Category	Definition	Example response
Technical/Protocol	Attribute the green/blue bubble distinction to differences in the underlying messaging systems, protocols, or technical incompatibilities between iOS and Android. These responses emphasize the mechanics, such as SMS/MMS vs. iMessage, encryption differences, or system-level incompatibilities.	"Apple uses iMessage to secure data, however this cannot be done with Android phones." *or* "Blue bubbles on iPhones use the iMessage app, while the green bubbles indicate that the messages are just text messages. iPhones also have the option to send green bubbles but I assume its only done when there is poor reception."
Feature Differentiation	Responses that highlight that green bubbles are used to signal differences in available messaging features, quality, or functionality when texting non-Apple users.	"I believe Android users don't have all the capabilities that iPhone users have over text which is why they highlight it green to show the difference in user." *or* "It lets you know if you're able to FaceTime the person/is a special feature"
Identification or Distinguishing Device Type	The response focuses on the green bubble as a simple identifier, without any suggestion of stigmatization or deliberate branding. The distinction is presented as a way for iPhone users to quickly recognize whether they are messaging another iPhone user or someone using a different device.	"To clarify to the iPhone user that an Android user is messaging them." *or* "Because blue is trademark for Apple. Green represents the android color green."

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Appendix Table A4: Hand-coding scheme: perceived reasons for green bubbles on iPhones when messaging Androids (continued)

Category	Definition	Example response
Branding, Marketing or Ecosystem Lock-in	Suggest Apple uses the green bubble distinction as part of a deliberate strategy to create exclusivity, social pressure, or brand loyalty. These responses often reference psychological tactics, group dynamics, or Apple's intention to market iPhones as superior.	"I think apple probably wanted to disincentivize people from getting androids by making the experience of texting those with them unideal." *or* "I think it is a marketing scheme to create a brand identity and group that those who text iPhones and show blue bubbles are one and the same and Andriod users are excluded from that."
Uncertainty/Other	Reasoning is unclear, speculative, or does not neatly fit into the other categories. These might express doubt, confusion, or provide vague explanations without much detail.	"I am not sure, maybe for uniqueness sake" *or* "They look green because the Android company wanted it that way."

Notes: The table provides an overview of the hand-coding scheme used to categorize open-ended responses to the question: "Why do you think messages sent from iPhones to Androids appear as green bubbles on iPhones?" This question was asked after informing participants about the existing compatibility issues that mark iPhone-to-Android communication and was asked to all participants irrespective of their operating system.

Appendix Table A5: Hand-coding scheme: support for or opposition to a software update making all bubbles blue

Category	Definition	Example response
Maintaining Brand Identity	Suggest that the color difference is a deliberate marketing tool by Apple to reinforce brand identity, exclusivity, and superiority. They see the color distinction as a business strategy rather than a technical necessity. Includes the belief that Apple has the right to maintain its brand identity.	"There was no reason not to have these features available to Android users to begin with, It is anti-consumer to have features withheld from the consumer when it is clearly easy and possible to implement them."
Social Stigma and Inequality	These responses either view the color distinction as fueling classism, bullying, or prejudice, and believe that by making all bubbles the same color, it would remove social pressure, end perceived snobbery, and create a more equal and accepting environment for all phone users. Or these responses reflect perceptions of social judgment, peer pressure, or a perceived lower social status associated with owning an Android.	"It would be better to eliminate the negative connotation associated with android users by eliminating bubbles." *or* "Because it would create equality and get rid of the stigma against android users."

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Appendix Table A5: Hand-coding scheme: support for or opposition to a software update making all bubbles blue (continued)

Category	Definition	Example response
Indifferent	These responses express that the entire debate is unimportant to them. The color of the message bubbles does not affect their day-to-day texting experience, so they remain neutral or uninterested in the issue.	"I don't think that the color difference is a big deal." *or* "Who really cares since its just texting and if it works why not include everyone".
Available Features	Knowing if the other person has an iPhone or Android helps anticipate which features are possible, such as FaceTime, emojis, iMessage games, voice messages, or high-quality file transfers.	"I like to see the different colors for the different phone users. This allows me to know whether I can communicate in certain ways, (i.e., FaceTime, emojis, etc...)." *or* "I feel like knowing that a person has an android based on this green bubble helps us know if we are able to use features like FaceTime or are able to send certain emojis."
Identification	Responses that argue that bubble colors serve a practical purpose by acting purely as a simple identifier for the type of device someone uses, without referencing underlying differences in features that can be used while messaging.	"I think that the green and blue messages should stay to let an iPhone user know if they are messaging with an Android or an iPhone." *or* "I wanna know the type of device i am receiving messages from."

Continued on next page

Appendix Table A5: Hand-coding scheme: support for or opposition to a software update making all bubbles blue (continued)

Category	Definition	Example response
Other	Do not fall into any of the other categories.	"I think that leaving it up to the user is a good idea. Just let the color of the chat be customized by the user to however they see fit." or "I believe it would just be far more simple this way than force different types of messing depending on phone. Type of phone should not matter while messaging anyone" *or* "I don't really know why, but it feels awkward to have the same colored bubble if you have a different phone type."
Aesthetic	These responses express a like or dislike for green bubbles based on aesthetic preferences.	"I like things to be uniform, so I would like all my messages to have the same appearance." *or* "You might as well have a cohesive design no matter the phone type."

Notes: The table outlines the hand-coding scheme used to categorize responses to a two-part question. The first part required a binary response regarding a hypothetical scenario—whether respondents would support an additional software feature that eliminates green bubbles by rendering all messages as blue bubbles on iPhones. Regardless of their binary choice, respondents were then asked to explain their reasoning.

Appendix Table A6: Hand-coding scheme: perceived reasons for or against the existence of a green bubble stigma

Category	Definition	Example response
Social Exclusion	Descriptions of Android users facing extreme forms of exclusion such as being left out of group chats, communication inconveniences, or feeling excluded due to green bubbles in a way that is not simply a joke or a meme.	"I have personally been discriminated against because I use an android device. I have been excluded from a group project and now I have to figure something out before the due date." *or* "I have personally experienced group members in university upset that they would not have an iMessage group chat when conducting projects, aiming their dismay at me for being the sole one out."
Class and Wealth Perceptions	Associations of green bubbles with being "poor," "lower class," or less financially capable.	"The common perception of Android phones is that it is cheaper than an iPhone and people who may not have the funds to purchase an iPhone will buy certainly buy an Android instead." *or* "I have seen people who use non Apple products be deemed as lower class."
Brand and Status Symbol	Viewing iPhones as a premium brand or a marker of social status, with green bubbles perceived as a lack of prestige. Includes responses which perceive this as a deliberate strategy by Apple.	"Is a way to create a brand identity and separate one another." *or* "Yes, because some iPhone users believe that Android users are different and inferior simply because of the type of phone they have. The green text bubble signifies inferiority."
Technical Issues	Complaints about functionality differences such as picture quality, group messaging compatibility, or integration issues.	"There is an idea that androids are lower quality and do not possess the same capabilities as iPhones do." *or* "iPhone users get annoyed at android users because of the lack of integration between the 2 systems. Photo sharing is difficult especially"

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Appendix Table A6: Hand-coding scheme: perceived reasons for or against the existence of a green bubble stigma (continued)

Category	Definition	Example response
Other	Do not fall into any of the other categories.	"People are judgemental of others choices" *or* "Most people have iPhones, so seeing something different always has an implied stigma."
Indifference	These responses express that the entire debate is unimportant to them. Can include acknowledgments that the stigma exists but is dismissed as insignificant.	"I do not think the color of a text message matters" *or* "What does it matter that someone uses SMS over iMessage? Who actually cares about that sort of thing?"
Joke	Acknowledgments that the stigma exists but is seen as a joke or meme, or that people are made fun of for using Androids.	"There are many jokes and memes about, for example, meeting someone you really like, getting their number, texting them and it's green, and saying ew nevermind. I think deep down no one really cares." *or* "On social media, it's a running joke for iPhone users to make fun of Android users."

Notes: The table summarizes the hand-coding scheme used to categorize responses to the two-part question: "Do you think that there is a social stigma against Android users whose text messages appear as green bubbles on iPhones?" In the first part, respondents provided a yes/no answer; in the second part, they explained their reasoning. This question was asked to all respondents.

LLM validation. We validate the hand-coding by classifying the same responses with GPT-4o through the OpenAI API, providing the model with the category definitions and examples above. We provide GPT-4o with the following prompt: "You will be supplied with a list of responses. These responses reflect thoughts on Android users versus iPhone users. Please classify responses based on the coding scheme below. Each open-ended response can fall into multiple categories or none." Then, we provide the different categories and examples of responses that would fit into each category. Table A7 reports correlations between hand-coded and LLM-coded categorizations.

Appendix Table A7: Validation of hand-coded data from Large Language Model

Panel A: Perceptions of what comes to mind when considering the average Android user versus the average iPhone user

	Stigma	Demographics	Neutral	Financial/ Practical	Technical	Green	Personality
Correlation coefficient	0.7448	0.7589	0.7775	0.7123	0.6725	0.9779	0.6673
	(0.030 7)	(0.029 9)	(0.028 9)	(0.032 2)	(0.034 0)	(0.009 6)	(0.034 2)
Hand-coded responses:							
Mean	0.3445	0.2416	0.1387	0.2584	0.2395	0.1029	0.2311
Std. dev.	0.4757	0.4285	0.3460	0.4382	0.4272	0.3042	0.4220
GPT-coded responses:							
Mean	0.3025	0.1597	0.1471	0.2899	0.2731	0.1071	0.2920
Std. dev.	0.4598	0.3667	0.3545	0.4542	0.4460	0.3096	0.4552
Observations	476	476	476	476	476	476	476

Panel B: Reasons for why messages sent from iPhones to Androids appear as green bubbles on iPhones

	Technical	Features	Identification	Branding	Other
Correlation coefficient	0.7633	0.6877	0.7364	0.9207	0.4652
	(0.029 7)	(0.033 3)	(0.031 1)	(0.017 9)	(0.040 7)
Hand-coded responses:					
Mean	0.3508	0.2164	0.1786	0.3929	0.0441
Std. dev.	0.4777	0.4122	0.3834	0.4889	0.2056
GPT-coded responses:					
Mean	0.4013	0.1975	0.2416	0.3761	0.0798
Std. dev.	0.4907	0.3985	0.4285	0.4849	0.2713
Observations	476	476	476	476	476

Panel C: Reasons for supporting/opposing an additional software feature that eliminates green bubbles for all

	Brand	Stigma	Indifferent	Identification	Features	Other	Aesthetic
Correlation coefficient	0.7326	0.8827	0.6287	0.7192	0.7219	0.3995	0.7667
	(0.031 3)	(0.021 6)	(0.035 7)	(0.031 9)	(0.031 8)	(0.042 1)	(0.029 5)
Hand-coded responses:							
Mean	0.1092	0.3172	0.1597	0.1071	0.1345	0.1513	0.1702
Std. dev.	0.3123	0.4659	0.3667	0.3096	0.3415	0.3587	0.3762
GPT-coded responses:							
Mean	0.0861	0.3046	0.1471	0.1408	0.1828	0.1282	0.2164
Std. dev.	0.2809	0.4607	0.3545	0.3481	0.3869	0.3346	0.4122
Observations	476	476	476	476	476	476	476

Panel D: Justifications for Social Stigma associated with Android users

	Exclusion	Class	Status	Technical Issues	Indifference	Other	Joke
Correlation coefficient	0.6186	0.9305	0.6811	0.8675	0.7787	0.5623	0.7174
	(0.036 1)	(0.016 8)	(0.033 6)	(0.022 8)	(0.028 8)	(0.038 0)	(0.032 0)
Hand-coded responses:							
Mean	0.1933	0.2647	0.1954	0.1408	0.0840	0.1891	0.1197
Std. dev.	0.3953	0.4416	0.3969	0.3481	0.2777	0.3920	0.3250
GPT-coded responses:							
Mean	0.2416	0.2710	0.2689	0.1345	0.1008	0.1303	0.1492
Std. dev.	0.4285	0.4449	0.4439	0.3415	0.3014	0.3369	0.3566
Observations	476	476	476	476	476	476	476

Notes: This table shows correlation coefficients between our manual and GPT-4o categorization of open-ended responses, with each column representing a classification category. Correlations are based on dummy variables set to 1 whenever a response was assigned to a given category under each coding method. The panels display, in chronological order, the results from our open-ended questions as described above. Standard errors are shown in parentheses. Correlation coefficients are computed using the Pearson correlation formula.

C.3 Additional Results from Open-Text Questions

Perceived reasons for green bubbles. Figure A1a shows the distribution of responses to the second open-ended question, asking why messages from Androids appear as green bubbles on iPhones. The question is asked after respondents are informed about existing compatibility issues but before any mention of the DOJ lawsuit.

Reasons for/against the blue-bubble update. Figure A1b shows reasons given for supporting or opposing a hypothetical software update making all messages appear as blue bubbles. Among respondents who prefer removing green bubbles, social stigma is the dominant rationale for Android users; iPhone users cite both stigma reduction and improved user experience.

Reasons for stigma beliefs. Figure A1c shows reasons given for believing (or not) that a social stigma exists against Android users.

Heterogeneity by phone type. Figures A2 and A3 show responses by respondent phone type. Stigmatizing references to Android users come predominantly from iPhone users; Android users instead emphasize personality traits.

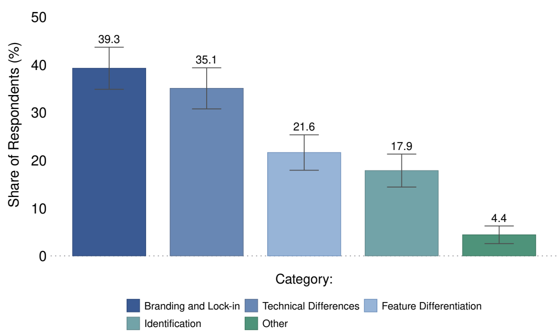
C.4 Compatibility-Fix Findings

The mechanism survey, fielded in September 2024 prior to the iOS 18 release, asked respondents about the perceived quality impact of two distinct changes: (i) adding read receipts and typing indicators to iPhone-Android messaging, and (ii) removing green bubbles. Figure A4 reports the share of respondents reporting no decrease in quality (3, 4, or 5 on a 1–5 Likert scale, where 3 is "No change in quality") for each change.

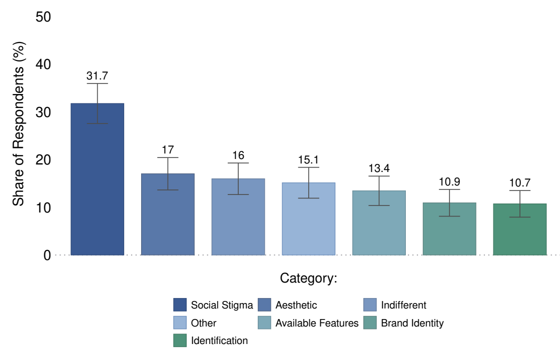
Adding read receipts and typing indicators does not lower the perceived quality of *either* Androids or iPhones. Removing green bubbles, by contrast, raises the perceived quality of Androids for a substantial share of respondents but leaves iPhone quality unchanged for over 60%.

This asymmetry is suggestive of Apple's product-design trade-off prior to iOS 18: closing the technical compatibility gap (read receipts, typing indicators) would have

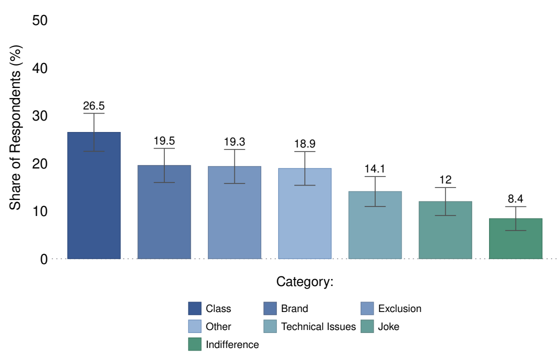
Appendix Figure A1: Hand-coding Results of Open-Ended Questions



(a) Reasons for the existence of green bubbles on iPhones when messaging Androids



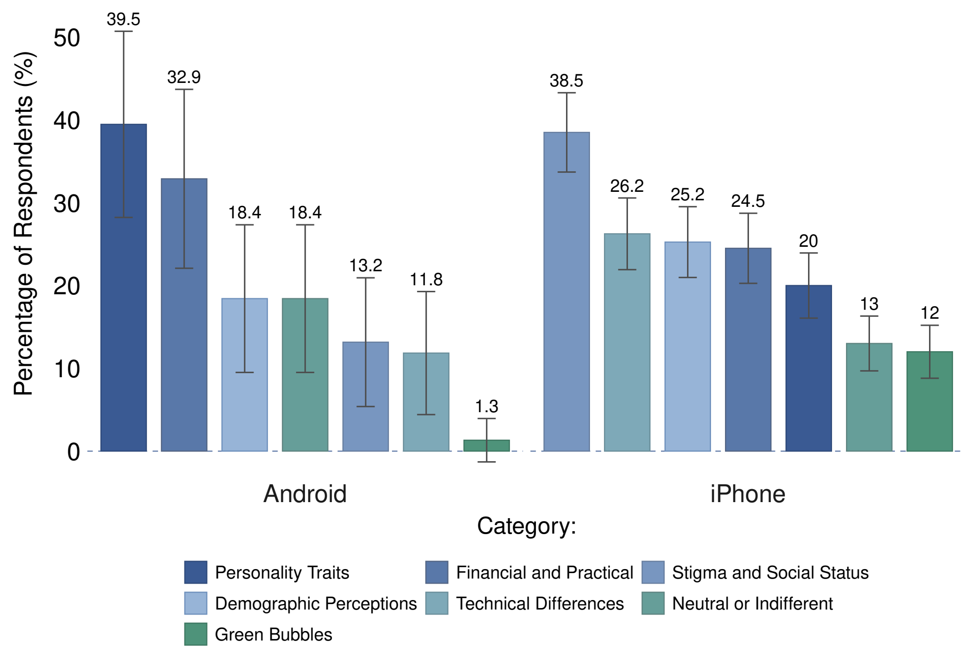
(b) Reasons for/against software update that makes bubbles blue on all devices



(c) Reasons for why respondents do/do not believe in the existence of a stigma against Android users

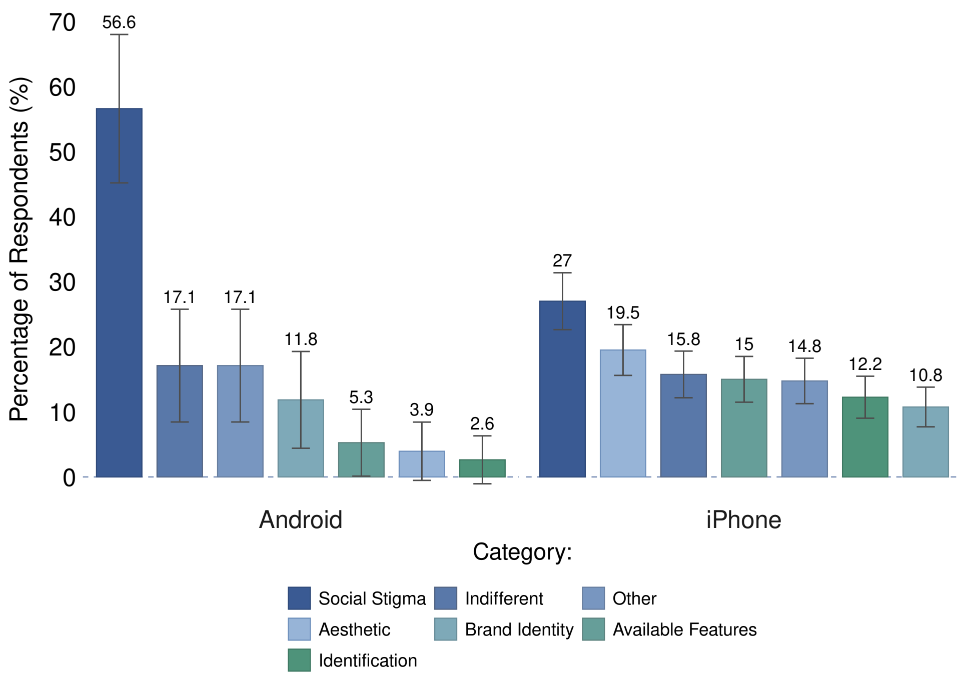
Notes: Each panel shows the distribution of hand-coded response categories for one open-ended question; categories are non-mutually exclusive. Panel (a): perceived reasons messages from Androids appear as green bubbles on iPhones. Panel (b): reasons for supporting or opposing a software update making all messages appear as blue bubbles. Panel (c): reasons for or against believing a social stigma exists against Android users. Sample restricted to respondents passing all attention checks and bot detection protocols.

Appendix Figure A2: Perceptions of What Comes to Mind When Considering the Average Android User vs. iPhone User, by Phone Type



Notes: This figure displays the distribution of hand-coded response categories to the question "When you think of someone who owns an Android instead of an iPhone, what comes to mind?", split by whether the respondent owns an iPhone or Android. Categories are not mutually exclusive. Sample restricted to respondents passing all attention checks and bot detection protocols.

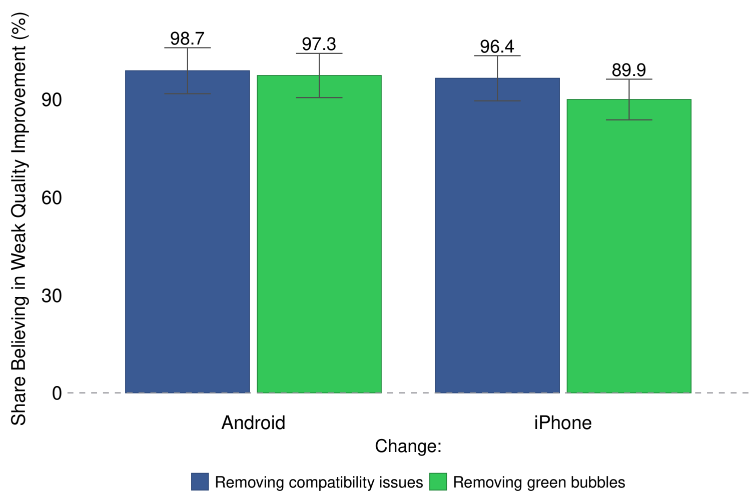
Appendix Figure A3: Reasons for Supporting/Opposing an Additional Software Feature that Eliminates Green Bubbles, by Phone Type



Notes: This figure displays the distribution of hand-coded response categories explaining why respondents support or oppose a hypothetical software feature that would make all messages appear as blue bubbles, split by phone type. Categories are not mutually exclusive. Sample restricted to respondents passing all attention checks and bot detection protocols.

improved the perceived quality of both phones, while the green bubble color distinction primarily degrades the outside option without improving the focal product. Apple's eventual adoption of RCS in iOS 18—which closed the technical gap but preserved the color distinction—is consistent with this pattern.

Appendix Figure A4: The Effect of Green Bubbles on Perceived Quality



Notes: This figure presents results on how removing compatibility issues or green bubbles affects the perceived quality of Androids and iPhones. We plot the percentage of respondents reporting no decrease in quality (3, 4, or 5 on a 1–5 Likert scale, where 3 is "No change in quality"). Sample restricted to respondents passing all attention checks and bot detection protocols. We report 95% confidence intervals.

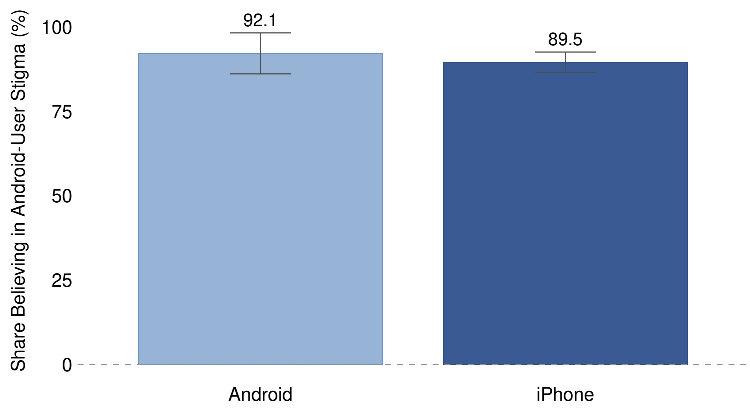
C.5 Structured Questions on Social Perceptions

Figure A5 shows that 90% of respondents agree that a social stigma exists against Android users whose messages appear as green bubbles, with strong majorities among both iPhone and Android users.

Figure A6 shows respondents' estimates of the average income of Android users in the U.S., relative to a benchmark iPhone user income of $53,000. The question is incentivized via a $100 lottery for the closest guess. On average, respondents perceive Android users as earning 10.5% less than iPhone users.

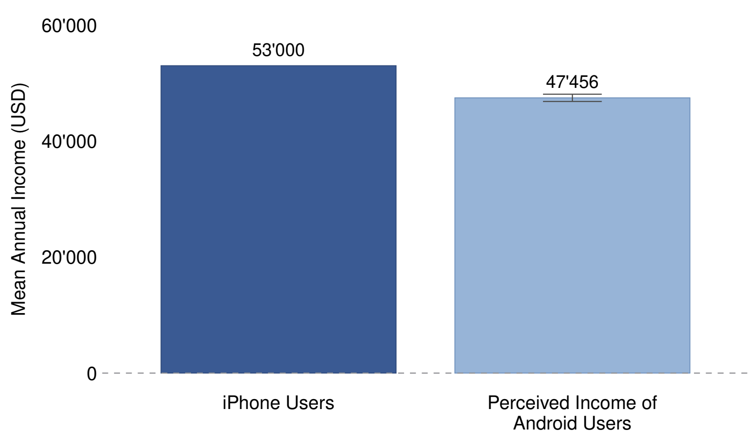
Figure A7 shows that 90% of iPhone users and 57% of Android users perceive iPhone users as more attractive than Android users.

Appendix Figure A5: Fraction of Respondents that Believe there is a Green Bubble Stigma



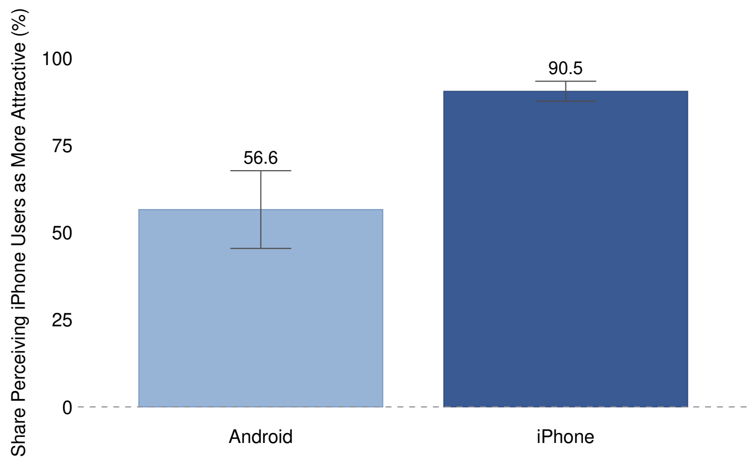
Notes: This figure displays the percentage of respondents who agree there is a social stigma associated with green bubbles, split by operating system. Respondents were asked: "Do you think that there is a social stigma against Android users whose text messages appear as green bubbles on iPhones?" Sample restricted to respondents passing all attention checks and bot detection protocols. We report 95% confidence intervals.

Appendix Figure A6: iPhone Users Believe that Android Users have Substantially Lower Income



Notes: This figure displays respondents' average estimate of the income of Android users in the U.S., relative to the average iPhone user income of $53,000. Income is computed by taking the mid-point of each income bracket in the choice options, as per our pre-registration. Sample restricted to respondents passing all attention checks and bot detection protocols. We report 95% confidence intervals.

Appendix Figure A7: Fraction of Respondents Believing iPhone Users are More Attractive



Notes: This figure displays the percentage of respondents who think the average iPhone user is more attractive than the average Android user. Respondents were asked: "Do you think that the average iPhone user is more or less attractive than the average Android user?" Sample restricted to respondents passing all attention checks and bot detection protocols. We report 95% confidence intervals.

C.6 Incentives and Perceived Stakes

Effort and extremism. 52.1% of respondents report putting in more effort as a result of the incentivization, 47.7% report no change, and only 1 respondent reported less effort. Reassuringly, 90.5% report no effect on the extremeness of their stated opinions; 7.8% report more extreme opinions and 1.7% less extreme.

Perceived stakes. Respondents report a mean perceived likelihood of 57.3% that the study results will be published in a major news outlet, and assign a mean probability of 41.3% to the DOJ lawsuit successfully forcing Apple to remove green bubbles. These figures suggest that the incentives were perceived as credible.

C.7 Robustness

Our pre-registration specifies that the main sample restricts to respondents passing all attention checks and bot detection protocols. Relaxing this restriction does not meaningfully change any of our results.

D The Welfare Cost of Non-User Externalities

This appendix provides supporting material for the deactivation experiment described in Section 4. We report sample characteristics, compliance with the deactivation protocol, and additional results on heterogeneity and robustness.

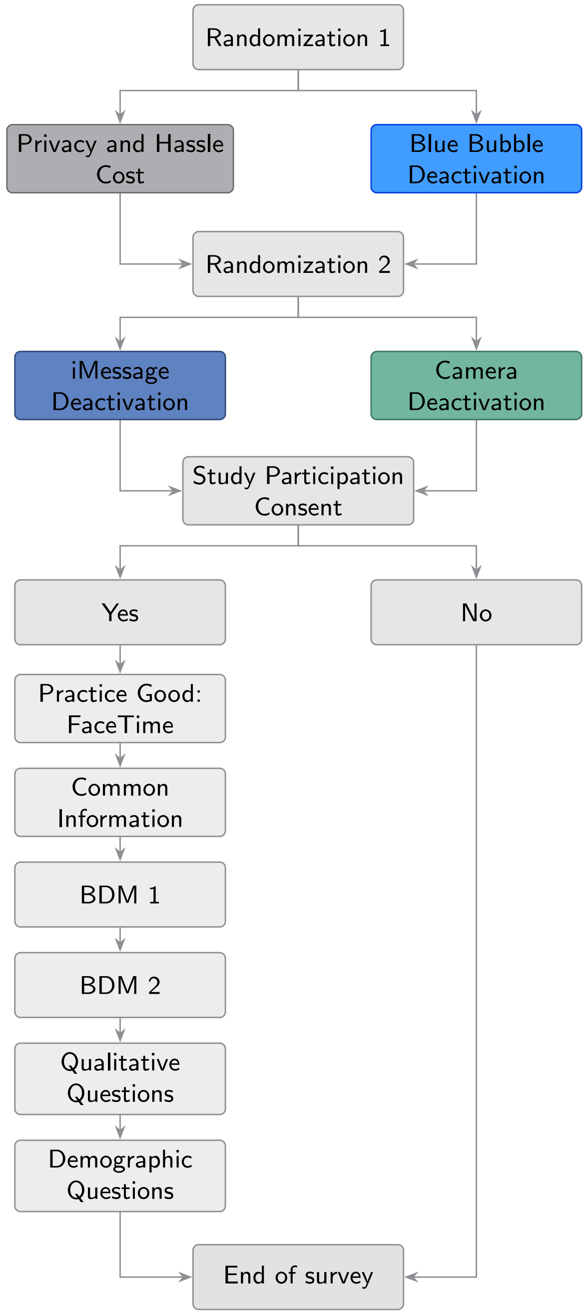
D.1 Sample Characteristics

Appendix Table A8: Demographics Summary Statistics for Deactivation Study Sample

Variable	Mean
Gender (Ind. for Female)	0.57
Age	20.45
Relationship Status (Ind. for Single)	0.56
Observations	344

Notes: This table summarizes demographic statistics for the deactivation study sample, restricted to respondents who passed all comprehension and attention checks. Variables are presented with their respective means.

Appendix Figure A8: Structure of Experiment: Deactivation Study



Notes: Participants are randomized into either the privacy and hassle cost control or the blue bubble deactivation, and then randomized into either the iMessage deactivation or camera deactivation option. Participants consent before their deactivation options are revealed. Those who consent proceed with the practice good for the Becker–DeGroot–Marschak (BDM) elicitation, receive common information on green bubbles, and then complete the BDM elicitation for their two deactivation options. The experiment concludes with qualitative questions and demographic characteristics. Yellow boxes indicate embedded data, blue boxes indicate question blocks, and the pink box indicates randomization.

D.2 Compliance and Implementation

As pre-specified, we selected 1 out of 10 respondents to be in the deactivation study, for a total of 40 participants. We exclude anyone with valuations outside our bounds, as well as anyone with a negative willingness-to-accept (WTA) as these are not incentive compatible. We then conduct the random computer draw, where we end up with 30 participants (14 iMessage and 16 camera) that we invite to participate in the deactivation study. We received a response indicating interest in participation from 22 (73%) people.[43] The deactivation period started on Monday, November 4th and ended on Sunday, December 1st. We find that 95%, or 21 out of 22, of our participants successfully completed the deactivation, for an average payout of $93. These results are comparable to previous large-scale deactivation experiments (Allcott et al., 2020) and provide further support that our design was perceived as credible.

[43] An additional person expressed interest in participating but encountered technical difficulties with their phone not receiving text messages so opted to not begin the deactivation.

D.3 Additional Results

Table A9 reports the main regression specification from Section 4, with and without demographic controls.

Appendix Table A9: Regression Results: Blue Bubbles Deactivation vs. Control

	(1)	(2)
Blue Bubbles	31.72***	31.14***
	(4.25)	(3.59)
Practice Good WTA		0.39***
		(0.04)
Male (Indicator=1)		3.40
		(3.39)
Constant	16.83***	−1.63
	(1.75)	(2.21)
R^2	0.15	0.41
Observations	344	342
Controls	No	Yes

Notes: This table displays regression results for our main specification without (Column 1) and with (Column 2) control variables. Both specifications were pre-specified. Column 2 contains two fewer observations due to two respondents not identifying as male or female. The coefficients on Blue Bubbles represent the difference in deactivation WTA between the Blue Bubbles group and the privacy and hassle cost control. Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

D.4 Subgroup Analysis

Table A10 splits the main specification by demographic subgroups and by perceived implementation likelihood.

D.5 Robustness Checks

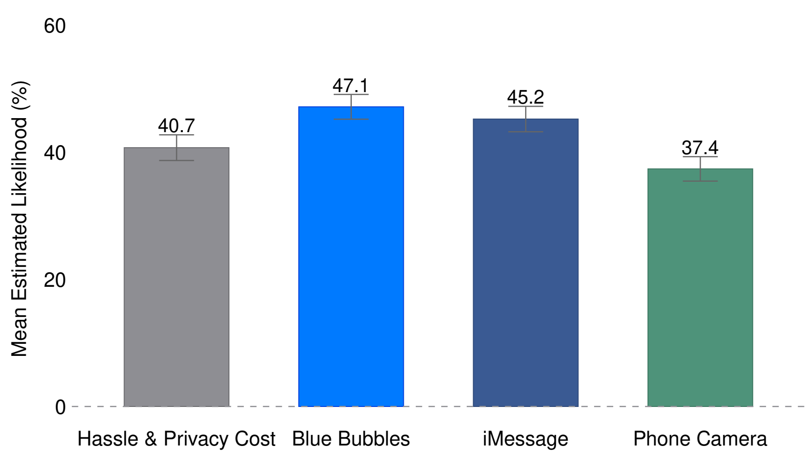
Top-coding. We find differential top-coding at our maximum value of $150 between the treatment and control condition, which suggests our estimate of the welfare cost of green bubbles is conservative. However, at the same time, we find significant differences in top-coding between the blue bubbles, iMessage, and camera deactivation, which likely understate our benchmark valuations. To address this issue, we focus on the median WTA compensation required to deactivate the phone features, as shown

Appendix Table A10: Heterogeneity for Regression Results: Blue Bubbles Deactivation vs. Control and by Perceived Likelihood

	Relationship Status		Gender		Perceived Likelihood	
	(1)	(2)	(3)	(4)	(5)	(6)
	In a Rel.	Single	Males	Females	Above Median	Below Median
Blue Bubbles	34.29***	29.55***	34.32***	28.75***	30.89***	32.35***
	(6.31)	(5.75)	(6.65)	(5.52)	(6.56)	(5.61)
Constant	16.41***	17.13***	17.60***	16.28***	16.96***	16.77***
	(2.30)	(2.52)	(2.71)	(2.31)	(2.87)	(2.17)
R^2	0.18	0.14	0.17	0.14	0.13	0.17
Observations	152	192	146	196	126	218

Notes: This table displays regression results for our main specification across demographic subgroups (Columns 1–4) and by median split on perceived implementation likelihood (Columns 5–6). The demographic splits were not pre-specified. Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

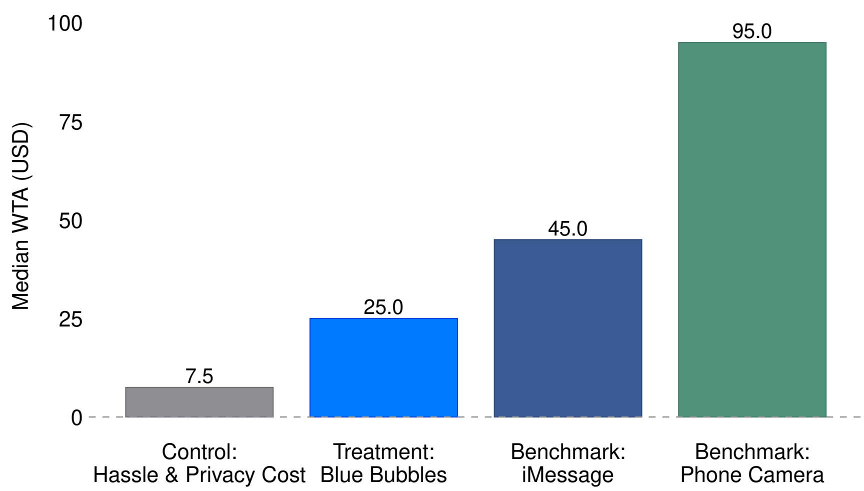
Appendix Figure A9: Perceived Credibility of Deactivation Options



Notes: This figure displays the average perceived likelihood that each deactivation option would be implemented. Respondents were asked: “For those respondents who are chosen to get their choices implemented, how likely do you think it is that the study just described in Option 1 will be the one selected for implementation?” Sample restricted to respondents passing all attention and comprehension checks. We report 95% confidence intervals.

in Figure A10. The median WTA for blue bubbles is \$25, which is substantially higher than the median hassle and privacy cost of \$7.5 and represents around 56% and 26% of the median iMessage and phone camera valuation, respectively. This still suggests a large economic significance to the consumer welfare costs of green bubbles compared to our benchmarks.

Appendix Figure A10: Median WTA to Deactivate Phone Features by Treatment

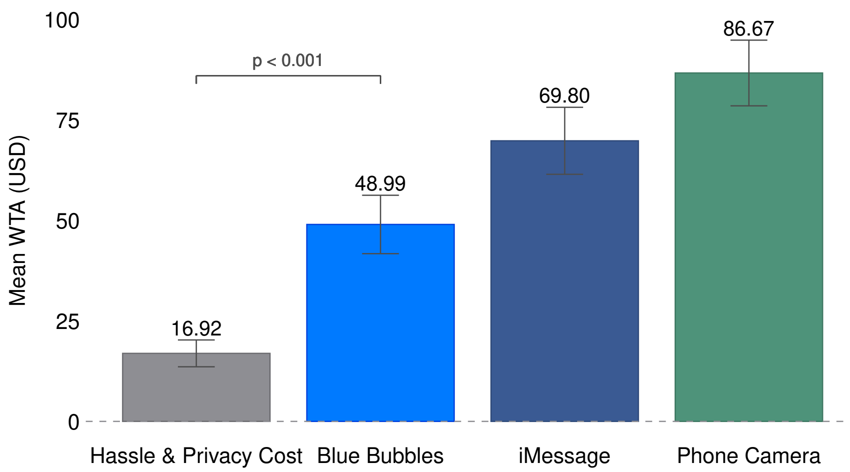


Notes: This figure displays the median WTA to deactivate various features of participants' iPhones for four weeks. Median valuations are unaffected by the differential top-coding at \$150 discussed in the text. We report 95% confidence intervals.

Robustness to regret. We allow our respondents to regret their valuations to ensure accurate data quality. After completing the multiple price list (MPL), we ask them if they would agree to participate in the deactivation for their implied valuation. Specifically, we ask whether they agree with the valuation implied by their answers to the MPL "According to your answers to the previous questions, you would need at most $\$X$ to participate and deactivate iMessage rather than not participate in the study". If they disagree, they are redirected to the start of the MPL and allowed to complete their decisions a second time. We asked them if they regret their choice a second time, but everyone proceeds with the next step regardless of their answer. In Option 1, we find that 5.0% of people regret their choice once and

0.99% of people regret their choice twice. In Option 2, we find that 5.8% of people regret their choice once and 0.25% of people regret their choice twice. In accordance with our pre-registration, we exclude anyone that regrets their choice twice, which is no respondent in our sample. Further, some respondents who regretted their initial valuation experienced a coding error causing the MPL to skip certain values on their second iteration (an ascending MPL omitting certain increments between $0 and $150). To err on the side of caution, we exclude anyone who regretted their initial valuation for Choice 1 or 2 (10.9%) from our main analysis. In Appendix Figure A11, we demonstrate that our results remain robust to their inclusion.

Appendix Figure A11: Average WTA to Deactivate Phone Features by Treatment (Including Single Regretters)



Notes: This figure displays the average WTA to deactivate various features of participants' iPhones for four weeks, including respondents who regretted their stated valuation for at least one feature once. We report 95% confidence intervals.

E Non-User Externalities and Product Demand

This appendix provides supporting material for the demand experiment described in Section 5. We report sample characteristics, the main regression results, heterogeneity and robustness checks, and a description of the additional demand experiment conducted around the iOS 18 release.

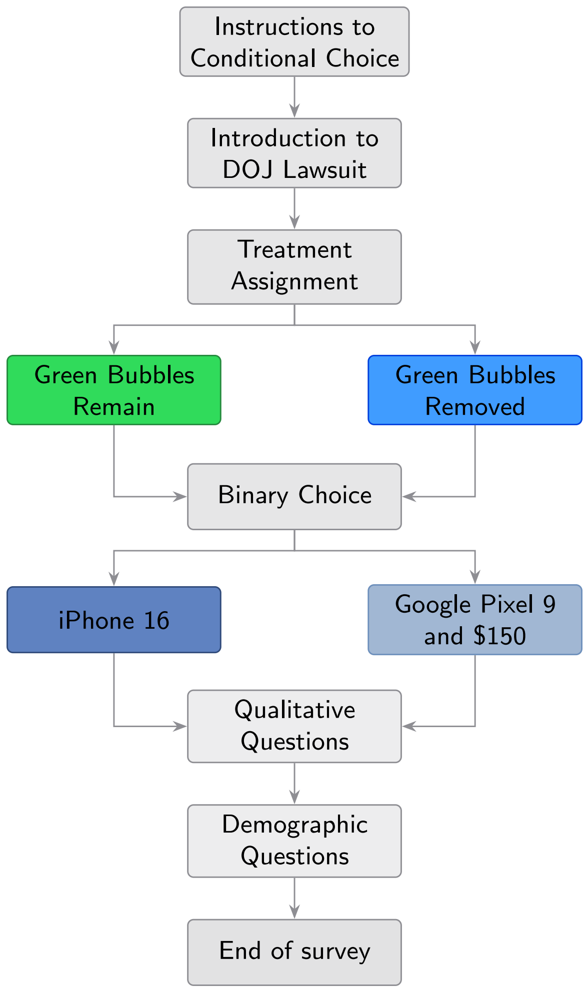
E.1 Sample Characteristics

Appendix Table A11: Demographics Summary Statistics for Demand Experiment Sample

Variable	Mean
Gender (Ind. for Female)	0.61
Age	21.45
Relationship Status (Ind. for Single)	0.54
Observations	468

Notes: This table summarizes demographic statistics for the demand experiment sample, restricted to respondents who passed all comprehension and attention checks. Variables are presented with their respective means.

Appendix Figure A12: Structure of Experiment: Product Demand



Notes: Participants are first told about the incentivized phone choice between the iPhone 16 and the Google Pixel 9 and are then informed about the ongoing DOJ lawsuit. Treatment assignment takes place and each respondent is brought to their respective decision screen for the binary choice. The experiment concludes by collecting responses to qualitative questions and demographic characteristics.

E.2 Additional Results

Table A12 reports the main pre-registered regression from Section 5.

Appendix Table A12: Regression Results: iPhone vs Android Choice

	(1)
Android Share	0.07**
	(0.04)
Constant	0.16***
	(0.02)
R^2	0.01
Observations	468

Notes: This table displays our main pre-registered regression. The coefficient represents the effect of our treatment on the choice of the Google Pixel 9 and $150 over the iPhone 16. Robust standard errors are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

E.3 Subgroup Analysis

Table A13 splits the main specification by demographic subgroups. Table A14 further splits by perceived likelihood and resale intentions.

Appendix Table A13: Heterogeneity for Regression Results: iPhone vs Android Choice

	(1) Males	(2) Females	(3) Single	(4) In a Rel.
Android Share	0.09	0.07	0.11**	0.02
	(0.06)	(0.05)	(0.05)	(0.05)
Constant	0.18***	0.14***	0.14***	0.18***
	(0.04)	(0.03)	(0.03)	(0.04)
R^2	0.01	0.01	0.02	0.00
Observations	180	283	254	214

Notes: This table displays the regression results for our main specification for different demographic subgroups of our sample, which were not pre-specified. For the first two columns, we exclude five individuals who identify as "other gender." Robust standard errors are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Appendix Table A14: Regression Results: iPhone vs Android Choice by Perceived Likelihood and Resale Lottery

	Perceived Likelihood		Resale Lottery	
	(1) Above Median	(2) Below Median	(3) Plan to Sell	(4) No Plan to Sell
Android Share	0.12**	0.04	−0.06	0.13***
	(0.06)	(0.05)	(0.07)	(0.04)
Constant	0.17***	0.14***	0.24***	0.11***
	(0.03)	(0.03)	(0.05)	(0.03)
R^2	0.02	0.00	0.00	0.03
Observations	230	238	141	327

Notes: This table displays our main regression split by perceived likelihood of the future scenario occurring (Columns 1–2) and by whether participants planned to resell the phone if they win the lottery (Columns 3–4). We place respondents in the same group who say they do not plan to sell or whose plans depend on which phone wins, as we assume these people would not plan to re-sell their preferred phone; Columns 3 and 4 therefore partition the analysis sample. The coefficient represents the effect of our treatment on the choice of the Google Pixel 9 and $150 over the iPhone 16. Robust standard errors are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

E.4 Robustness Checks

Robustness to regret. We allow our respondents to regret their valuations to ensure accurate data quality. If they disagree with their initial choice, they are redirected to the decision screen and allowed to complete their decision a second time. We asked them if they regret their choice a second time, but everyone proceeds with the next step regardless of their answer. We find that 2% of people regret their choice once and 0% of people regret their choice twice. Our low values of regret are likely helped by including several attention and comprehension checks before participants proceed to the decision.

Table A15 shows that our results are robust to excluding respondents who regretted their valuations at least once (Column 1), and to including Canadians, respondents aged 18–27, and iPhone 16 users (Column 2).

Appendix Table A15: Robustness: iPhone vs Android Choice

	(1) Excl. Regretters	(2) All Respondents
Android Share	0.08**	0.09**
	(0.04)	(0.03)
Constant	0.15***	0.16***
	(0.02)	(0.02)
R^2	0.01	0.01
Observations	459	575

Notes: This table displays robustness checks for our main regression. Column 1 excludes respondents who regretted their valuations at least once. Column 2 includes all collected responses (no age, citizenship, or phone model filters). The coefficient represents the effect of our treatment on the choice of the Google Pixel 9 and $150 over the iPhone 16. Robust standard errors are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

E.5 Additional Demand Experiment (iOS 18)

This section describes the additional demand experiment conducted around the release of iOS 18 in August–September 2024. This experiment uses a Becker–DeGroot–Marschak (BDM) elicitation to measure willingness to pay (WTP), whereas the main experiment in Section 5 uses a binary choice design.

E.5.1 Sample

We collaborated with College Pulse and Prolific to recruit U.S. iPhone owners, aged between 18 and 25. Our data collection took place in August and September 2024.[44]

E.5.2 Preregistration

Our data collection was preregistered on AsPredicted (#188626 and #189888) and includes the experimental design, hypotheses, primary and secondary outcomes, sample size, and exclusion criteria.[45] We pool the results across Prolific and College Pulse to maximize power and to reach close to our pre-specified target sample size of

[44] We conducted the experiment using College Pulse, CloudResearch, and Prolific. Due to concerns about data quality, we excluded all responses from CloudResearch, as the majority appeared to be bot-generated. Similarly, we identified and removed a subset of College Pulse responses flagged as bots. Our final sample consists solely of respondents from College Pulse and Prolific who were not flagged as bots.

[45] For details, see `https://aspredicted.org/4tp9-tvzr.pdf` and `https://aspredicted.org/4ytf-zgwq.pdf`.

1,500.[46] Because the pre-registrations differed slightly across samples, we relaxed the exclusion criteria to ensure the same inclusion rules applied to both.[47]

E.5.3 Design

Our survey begins by asking respondents to specify which phone model they currently own. We then inform respondents that after this survey we will hold a lottery for a smartphone and a monetary payment: they can choose to win an iPhone 16 Pro Max—the iPhone 15 Pro Max in the College Pulse sample—or a Galaxy S24 Ultra, and 1 out of 200 participants will be selected as the winner.

We then explain the BDM procedure. Respondents first choose the phone they like better, then specify the minimum amount of extra money they would need to switch from their preferred phone to the other one.[48] We emphasize that it is in the respondent's best interest to be truthful. Comprehension is verified with a simple question about the BDM mechanism.

To enhance comprehension, we start with a hypothetical example good (Dizon-Ross and Jayachandran, 2022): respondents report their preferences over two laptops (a 16-inch, M2 MacBook Pro and a Lenovo ThinkPad X1 Extreme Gen 4), both priced around $2,300, and specify the minimum amount they would require to switch from their preferred laptop to the other one.

E.5.4 Common information about interoperability issues

All respondents are first reminded of the interoperability issues between Androids and iPhones. In particular, respondents are told that Android users do not have access to read receipts or typing indicators and can only send low-quality pictures and videos to iPhones and vice versa. They are further told that the messages sent between Androids and iPhones appear as green bubbles on iPhones, even in group chats, while texts between iPhones appear as blue bubbles.

[46]We used multiple survey providers to increase collection speed as our data collection had to be completed by the end of the iOS 18 launch day on September 16th. At the time of each experiment, we used the latest iPhone model available: the iPhone 15 Pro Max for the College Pulse study and the iPhone 16 Pro Max for the Prolific study.

[47]29.0% of individuals fail our attention checks.

[48]To ensure that respondents understand that choices are incentive-compatible, we inform them that a computer will generate a random monetary offer. If the offer is less than the minimum amount they specified to switch to their less preferred phone, they will get the phone they prefer. If the computer's offer is at least as high as the amount, they will get the other phone and the extra money.

To illustrate how the compatibility issues affect the user experience, we provide respondents with a video. All respondents then complete a comprehension question about the content of the video, and only those who pass can proceed with the rest of the experiment.

E.5.5 Treatment groups

In our experiment we randomly assign respondents to one of two treatment groups: A green bubble group and a blue bubble group.

E.5.6 Green bubbles treatment

Respondents in the green bubbles treatment are informed about Apple's announcement that the new iOS 18 operating system, coming in mid-September, will fix most of the compatibility issues between Androids and iPhones. In particular, respondents learn that Apple will use Rich Communication Service (RCS) to enable Android users to have read receipts and typing indicators, and be able to send high quality pictures and videos when sending texts to iPhones and vice versa. Respondents are further told that messages sent between Androids and iPhones will still appear as green bubbles. We again illustrate what this change means through a video which illustrates people's messaging experience under iOS 18.[49]

E.5.7 Blue bubbles treatment

Respondents in the Blue bubbles treatment receive the same information about iOS 18 eliminating interoperability issues as respondents in the Green bubbles treatment. Respondents are further told that more recent technological advancements also make it possible that messages sent between Androids and iPhones appear as blue bubbles.[50] As in the green bubbles treatment, we show respondents a video which illustrates people's messaging experience under iOS 18 and with blue bubbles.[51]

[49] We use an iPhone with the iOS 18 Public Beta to record this video between an iPhone using RCS and an Android with RCS.

[50] We debrief participants of our experiment at the very end of the survey and explain that this is made possible by a new app called BlueBubbles. We do so in order to avoid respondents mistakenly believing that Green bubbles will be eliminated as a result of iOS 18.

[51] This video is recorded by an iPhone using the iOS 18 beta and messaging with an Android using the BlueBubbles app. The common information video can be viewed at: `https://youtu.be/ZUE1L0ZQJHU`, the green bubbles treatment at: `https://youtu.be/hQHmg9zufDg`, and the blue

E.5.8 WTP for receiving the preferred phone

Subsequently, all respondents move to the main outcome measure, a respondent's incentivized willingness to pay to receive their preferred phone. In particular, respondents first decide whether they prefer a Galaxy S24 Ultra or an iPhone 16 Pro Max, both of which cost around $1,250[52]. We then remind respondents about some basic features of the BDM elicitation and inform them they will receive the phone in October, should they win the lottery. After respondents' choice of which phone they prefer, we ask them for the smallest amount of money that would make them choose the less preferred phone. We then ask respondents whether they agree with their stated choices.

E.5.9 Discussion of the design

One concern revolves around misunderstandings about the BDM elicitation. To mitigate this, we include a comprehension question about the BDM mechanism, an example good, and ask respondents whether they regret their choices in the practice example and phone BDM elicitation. Specifically, we ask them whether they agree with a statement about what their choices imply. For example, a respondent with an excess valuation of a MacBook of $300 is asked whether they agree with the statement that "According to your answers to the previous questions, you would be willing to forgo $300 to get a MacBook Pro (16-inch, M2 Pro) instead of a Lenovo ThinkPad X1 Extreme Gen 4." If respondents do not agree, they are asked to complete the elicitation one more time, and informed that this will be their last chance to modify their answers. Our main sample is restricted to respondents who do not regret their final answers (i.e., we drop two-time regretters in the phone BDM elicitation).

E.5.10 Research ethics

A key challenge for our design lies in creating the expectation that blue bubbles will be eliminated. The instructions rely on language suggesting that blue bubbles will replace green bubbles for all users. We use language that leverages the fact that new technological advances would allow users to get blue bubbles, e.g. by installing

bubbles treatment at: `https://youtu.be/V0DjJ-rja1M`.

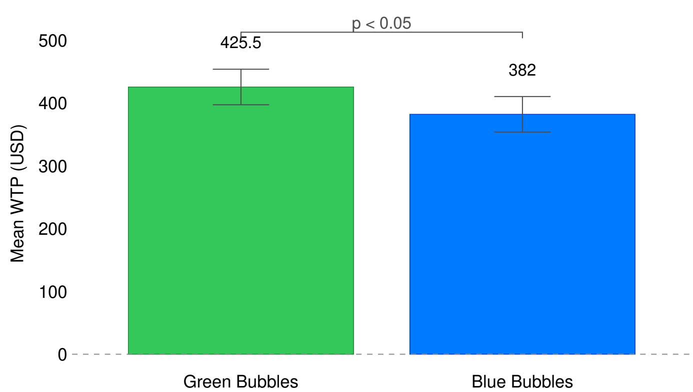
[52]This represents the average of the two phones. Specifically, at the time of the experiment, the Samsung Galaxy S24 Ultra was priced around $1,300 while the iPhone 16 Pro Max was priced around $1,200.

the BlueBubbles app. While we do not lie to participants, our approach may come close to the boundary of deception. We adopted this approach because it appeared to be the only practically feasible way to elicit incentivized willingness to pay for the scenario that green bubbles are replaced by blue bubbles for everyone in the iOS 18 update.

E.5.11 Results

Figure A13 illustrates the main pre-registered results. Respondents in the Blue Bubble treatment have a \$43 lower WTP for the iPhone 16 Pro Max compared to respondents in the Green Bubble treatment ($p = 0.033$). These effects are substantial in magnitude and correspond to 3.5% of the cost of the iPhone.

Appendix Figure A13: Average Incentivized WTP for the iPhone 16 Pro Max over the Samsung Galaxy S24 Ultra



Notes: This figure displays the average WTP for the iPhone 16 Pro Max over the Samsung Galaxy S24 Ultra by treatment status. We report 95% confidence intervals.

E.5.12 Non-user externality and quality misperceptions

Non-user externality can create "lock-in" effects that may contribute to misperceptions of the quality of the outside option, possibly from lack of information acquisition. To investigate this mechanism, we conducted a pre-registered survey collection on the perceptions of Android quality relative to iPhones as part of the iMessage deactivation study.

We find that over 68% of our sample respondents underestimate the display quality (as measured through display resolution) of the Galaxy S24 Ultra compared to the iPhone 16 Pro Max. Similarly, 52% of people underestimate the camera quality of the Galaxy S24 Ultra (as measured through camera megapixels) compared to the iPhone 16 Pro Max. We interpret this as suggestive evidence that our effects are capturing a lower bound of the treatment effect size as increasing non-user externality may result in quality perceptions being updated through either more information acquisition or through social network spillovers as Android market share increases.

F Non-User Externalities Across Product Features

This appendix provides supporting material for the feature survey described in Section 6. We report sample characteristics, the feature roster, the preference and perceived-quality results by feature, the mechanism question, and robustness checks.

F.1 Sample Characteristics

Appendix Table A16: Demographics Summary Statistics for Feature Survey Sample

Variable	Mean
Female	0.56
Age	20.56
Single	0.57
Uses the product they rated	0.61
Passed the attention check	0.81
Completion time in minutes	3.33
Respondents	500
Respondent × feature ratings	2,000

Notes: This table summarizes the feature survey sample. Gender, age and relationship status are shares of the 500 respondents. "Uses the product they rated" is a share of the 2000 respondent × feature ratings. The attention-check pass rate is computed over all 670 completers, since the analysis sample excludes the respondents who failed it.

Appendix Table A17: Sample Restrictions for Feature Survey Sample

	Respondents
Raw responses	743
Not a college student	57
Outside the 18–23 age range	5
Abandoned at the screener	1
Reached the feature questions	680
Did not finish	10
Completed	670
Failed the attention check	129
Failed the automated-response screen	52
Analysis sample	500
Respondent $\times$ feature ratings	2,000

Notes: This table traces the sample from raw responses to the analysis sample. Eligibility is enforced by a screener that terminates ineligible respondents before they see any feature; those restrictions are applied in the order stated and are mutually exclusive. The attention and automated-response exclusions apply to respondents who completed and are not mutually exclusive, so they need not sum to the difference between rows. We apply every pre-registered exclusion except the two based on Qualtrics RelevantID scores, which the export does not carry.

F.2 Feature Roster

Table A18 lists the nine features, the two comparison groups for each, and the channel the mechanism question names. Table A19 reports every outcome by feature.

Appendix Table A18: Feature Roster

Design choice	Counterfactual	Margin	Users	Outside group	Channel	Mechanism question (Yes/No)
Apple's green bubbles	all messages appear in blue	Extensive	iPhones	Android phones	Status	Do you think green bubbles make Android users feel lower status?
Apple's AirDrop	AirDrop also transfers files to Android phones	Extensive	iPhones	Android phones	Exclusion	Do you think AirDrop working only between Apple devices makes Android users feel excluded?
Instagram's Stories	Stories remain visible for 48 hours	Intensive	frequent Instagram users	occasional Instagram users	Pressure	Do you think Stories disappearing after 24 hours pressures occasional Instagram users to check Instagram more often?
Strava's activity feed	workouts private by default	Intensive	frequent Strava users	occasional Strava users	Pressure	Do you think Strava posting workouts to friends by default pressures occasional Strava users to work out and post more often?
Nike's Air Jordan drops	sold-out colorways regularly restocked	Intensive	frequent Air Jordan buyers	occasional Air Jordan buyers	Status	Do you think limited Air Jordan drops make occasional Air Jordan buyers feel lower status?
Bumble's match expiration	matches do not expire	Intensive	frequent Bumble users	occasional Bumble users	Pressure	Do you think Bumble's 24-hour match expiry pressures occasional Bumble users to check Bumble more often?
Google's Street View†	Google Maps without Street View	Extensive	Google Maps	Apple Maps	Exclusion	Do you think Google Maps Street View makes Apple Maps users feel excluded?
Snapchat's Memories†	Snapchat without the archive	Extensive	Snapchat	Instagram	Exclusion	Do you think Snapchat's Memories feature makes Instagram users feel excluded?
Spotify's Discover Weekly†	Spotify without the weekly playlist	Extensive	Spotify	Apple Music	Status	Do you think Spotify's Discover Weekly makes Apple Music users feel lower status?

Notes: This table reports the design choice, the counterfactual, whether the outside group is a rival's users (extensive margin) or the product's own occasional users (intensive margin), the two comparison groups, the channel, and the mechanism question asked after the feature loop. † marks the three control features, which are internal to the user experience and reach no group outside the product; their mechanism questions are worded in parallel with a feature sharing the same channel.

Appendix Table A19: Per-Feature Summary

Design choice	N	Respondents who use it	Respondents who do not	Prefer counterfact. (%)	Quality change users	Quality change outside	Channel Yes (%)
Apple's AirDrop	242	207	35	81	0.81	0.83	83
Strava's activity feed	223	40	183	78	0.36	0.65	69
Apple's green bubbles	203	171	32	52	0.15	0.24	72
Bumble's match expiration	215	20	195	53	0.14	0.33	89
Instagram's Stories	224	210	14	21	−0.05	0.26	75
Nike's Air Jordan drops	221	56	165	64	−0.07	0.31	49
Spotify's Discover Weekly†	219	172	47	9	−0.47	0.21	15
Snapchat's Memories†	227	145	82	4	−1.13	0.19	13
Google's Street View†	226	197	29	1	−1.16	0.14	25
Control features (pooled)						0.18	

Notes: "Respondents who use it / do not" counts respondents by their answer to the use question for that product. "Prefer counterfact." is the share preferring the state of the world in which the firm has chosen otherwise. "Quality change" is the mean perceived change under that counterfactual on the recoded $-2 \cdots +2$ scale, for the product's users and for the outside group; Figure A14 plots the same means with 95% confidence intervals. "Channel Yes" is the share attributing the channel. † marks control features. The final row pools the three control features on the outside-group side.

F.3 Preference over the Design

Table A20 splits the shares of Figure 5, Panel (a), by whether the respondent uses the product. The split identifies the outside group for green bubbles and AirDrop, the two extensive-margin features we study: there the outside group is a rival's users, and not using the product is what places a respondent in it. For the four intensive-margin features the outside group is the product's own occasional users, and our use question is binary. The non-user column for those features therefore contrasts people outside the product with people inside it, a coarser cut than the outside-group question names.

Appendix Table A20: Preference over the Design by Use Status

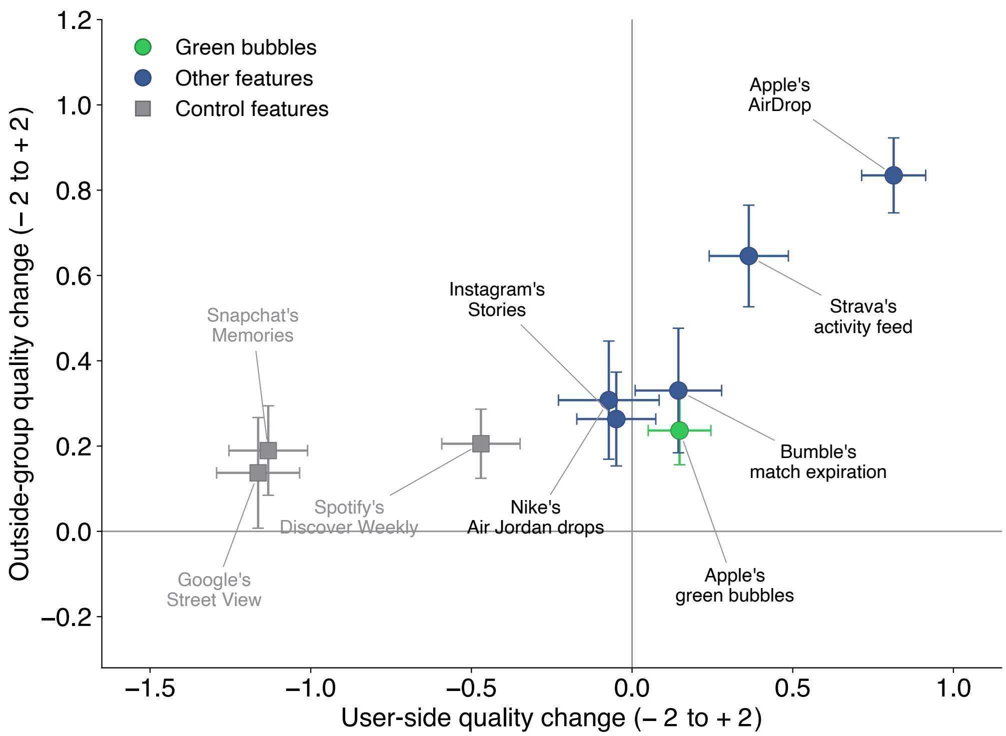
	Users		Non-users		
Design choice	%	N	%	N	Gap (pp)
Apple's AirDrop	81	207	80	35	−1.2
Strava's activity feed	62	40	82	183	19.5**
Apple's green bubbles	47	171	78	32	31.3***
Bumble's match expiration	65	20	52	195	−12.7
Instagram's Stories	20	210	36	14	15.2
Nike's Air Jordan drops	54	56	67	165	13.7*
Spotify's Discover Weekly†	9	172	11	47	1.9
Snapchat's Memories†	2	145	6	82	4.0
Google's Street View†	1	197	3	29	2.9

Notes: This table reports the share preferring the state of the world in which the firm has chosen otherwise, by whether the respondent reports using the product. "Gap" is non-users minus users in percentage points, from a Welch two-sample test. The use question is binary, so for intensive-margin features the non-user column holds respondents who do not use the product rather than the occasional users the outside-group question names. Two features leave one column thin: Bumble is used by 20 of the respondents who rated it, and Instagram by all but 14. † marks control features. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

F.4 Perceived Quality

Figure A14 places each feature in (user-side, outside-group) space. The features we study cluster just above the origin, combining an outside-group gain with a user side near zero; the control features sit far to the left, where rolling back a valued feature sharply lowers quality for the product's own users. No control feature occupies the region the others do.

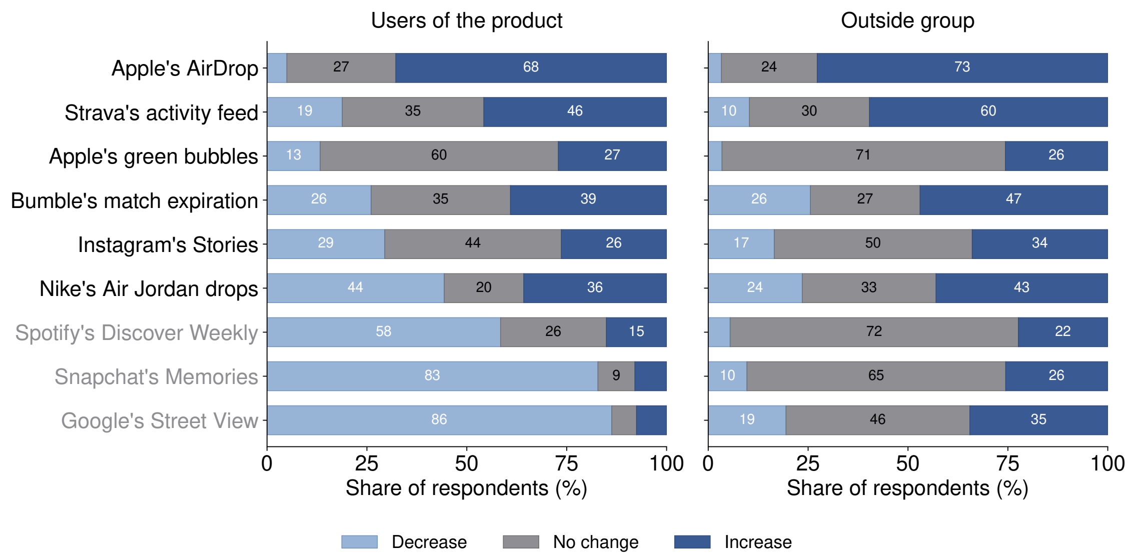
Appendix Figure A14: Perceived Quality Change for Users and for the Outside Group



Notes: This figure displays the mean perceived quality change under the counterfactual, on a five-point scale from "Strongly decrease" (−2) to "Strongly increase" (+2), rated separately for users of the product and for the outside group. Error bars are 95% confidence intervals. The outside group is a rival's users for extensive-margin features and the product's occasional users for intensive-margin features. Control features are internal to the user experience and reach no group outside the product.

Figure A15 splits the same ratings by direction, and shows how much of each mean rests on a modal "no change". For green bubbles, 59.6% report no change for iPhones and 70.9% for Android phones. The outside-group mean is carried by the minority who report an increase rather than by a general shift, which is why we read these ratings as directional and do not interpret their magnitudes.

Appendix Figure A15: Direction of the Perceived Quality Change by Feature



Notes: This figure displays the share of respondents rating the quality change under the counterfactual as a decrease (-2 or -1), no change (0), or an increase ($+1$ or $+2$), separately for users of the product and for the outside group. Features are ordered by mean quality change for the product's users. Control-feature labels in grey.

Levels on the outside-group side are compressed, and the control features return $+0.18$ there rather than zero. Their construction gives a reading for why. All three are extensive-margin features, so the outside group is a named rival, and the counterfactual removes a feature the product's own users value. Asking how Apple Music's quality changes when Spotify removes a valued playlist has a substitution answer that is positive without any externality reasoning. A positive reading is therefore consistent with ordinary competitive substitution as much as with an acquiescent response style, and these data cannot separate the two.

Section 6 reports outside-group levels, which are positive for every feature. Table A21 reports the contrast against the control features instead, netting out individual differences in scale use with a respondent fixed effect so that each feature is identified from within-respondent variation across the features that respondent rated. On that contrast, AirDrop and Strava separate on the outside-group side and the remaining four do not, against a control base of $+0.18$. Column 1 gives the same contrast on the user side, where every feature separates: rolling back a control feature costs its users far more than reversing any of the six design choices.

Appendix Table A21: Within-Person Quality Change Relative to the Control Features

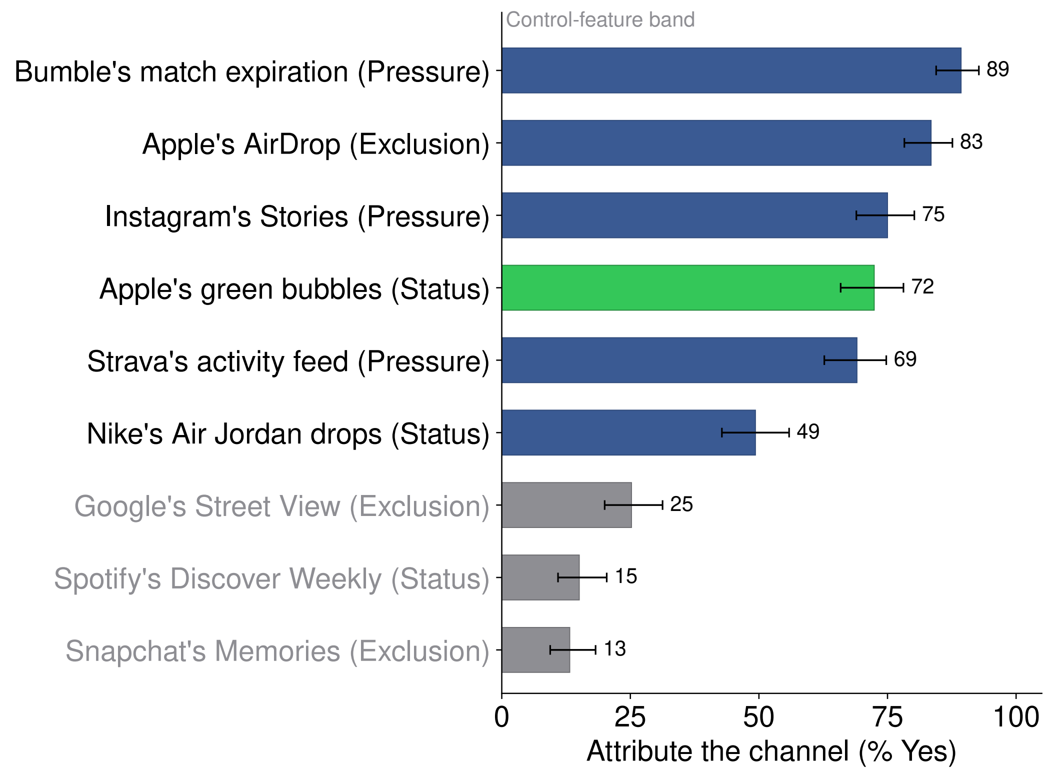
	Users of the product (1)	Outside group (2)
Apple's green bubbles	1.08***	0.09
	(0.08)	(0.07)
Apple's AirDrop	1.67***	0.59***
	(0.08)	(0.07)
Instagram's Stories	0.78***	0.04
	(0.09)	(0.08)
Strava's activity feed	1.21***	0.38***
	(0.09)	(0.08)
Nike's Air Jordan drops	0.80***	0.09
	(0.10)	(0.09)
Bumble's match expiration	1.04***	0.13
	(0.09)	(0.10)
All features above (pooled)	1.11***	0.23***
	(0.06)	(0.05)
Respondent fixed effects	Yes	Yes
Respondents	500	500
Observations	2,000	2,000

Notes: This table displays OLS estimates of the perceived quality change under the counterfactual, relative to the three control features, which are the omitted category. Column 1 is the change for users of the product and Column 2 for the outside group. "All features above (pooled)" replaces the per-feature indicators with a single indicator for a non-control feature. Standard errors clustered by respondent in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

F.5 Mechanism

Figure A16 reports the mechanism question by feature, with the channel each question names. Section 6 reports the same shares grouped by channel.

Appendix Figure A16: Share Attributing the Channel



Notes: This figure displays the share answering "Yes" to the mechanism question asked after the feature loop, with 95% Wilson intervals. The channel each question names is in parentheses. The shaded band spans the three control features. Sample restricted to respondents who rated the feature in question.

F.6 Robustness Checks

Order of the two quality screens. Rating the product first could contaminate the outside-group rating that follows. We randomize and record which screen a respondent sees first. Table A22 reports means by order and the pooled feature-adjusted effect. Showing the outside screen first moves the outside-group rating by -0.06 ($p = 0.146$) and the user-side rating by $+0.00$ ($p = 0.992$).

Appendix Table A22: Robustness: Order of the Two Quality Screens

	Q (user)	Q (outside)
Focal side shown first	−0.16 [−0.23, −0.09]	+0.39 [+0.33, +0.44]
Outside side shown first	−0.15 [−0.22, −0.08]	+0.33 [+0.27, +0.38]
Outside-first effect	+0.00 (0.05)	−0.06 (0.04)
Feature fixed effects	Yes	Yes
SE clustered by respondent	Yes	Yes
Observations	2000	2000
Respondents	500	500

Notes: The first two rows report unconditional means by which quality screen the respondent saw first, pooled across all nine features and therefore not comparable in level to any single feature. "Outside-first effect" is the coefficient on an indicator for the outside screen appearing first, from a regression with feature fixed effects. Standard errors clustered by respondent in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

What the preference measure compares. The two states of the world are not symmetric across the roster in what the counterfactual does. On the six features we study it lifts a restriction or adds a capability: blue bubbles for every contact, AirDrop that reaches Android, a private-by-default feed, matches that do not expire. On the three control features it removes a valued feature. A respondent applying nothing more than a preference for capability over removal would reproduce the contrast between the two groups of features in the levels. The comparison within a feature is unaffected, since the wording, the framing and the feature are held fixed and only the respondent's group membership varies.

G Survey and Experimental Protocols

G.1 Overview of Data Collections

This appendix reproduces the full survey instruments for each data collection. The remainder of this section proceeds as follows: Section G.2 presents the mechanism survey on green bubble stigma; Section G.3 presents the iMessage deactivation experiment; Section G.4 presents the main demand experiment; Section G.5 presents the additional (iOS 18) demand experiment; and Section G.6 presents the feature-level survey.

Appendix Table A23: Overview of Data Collections

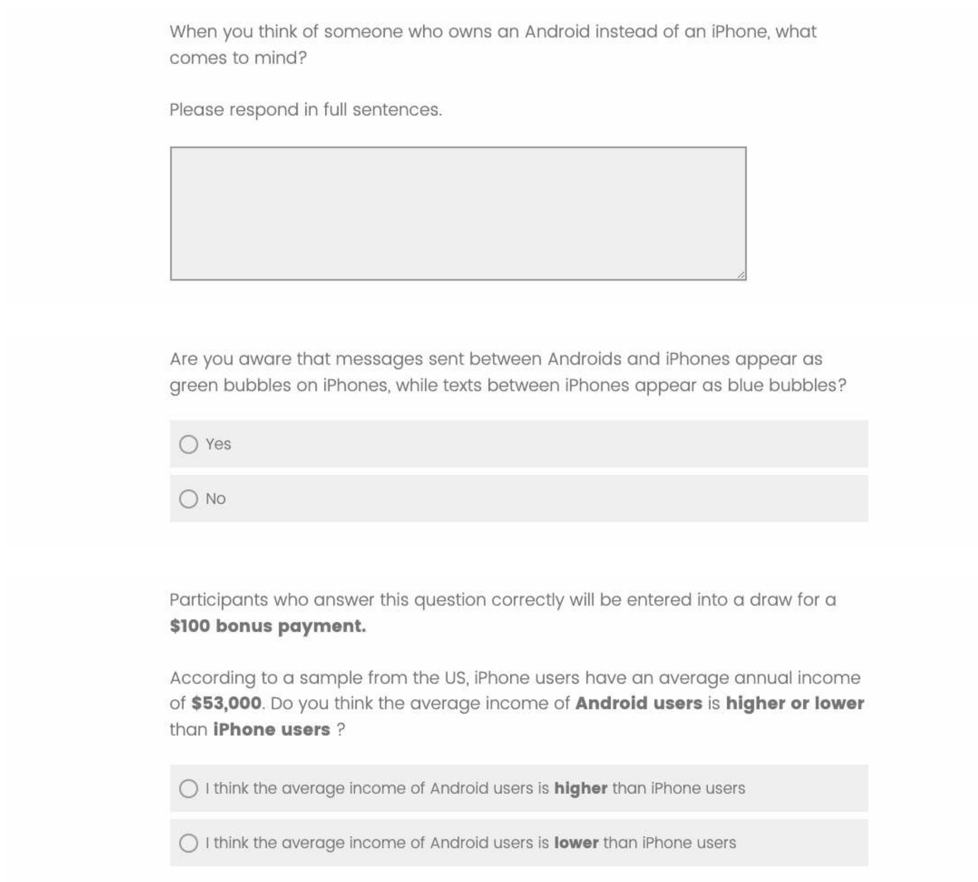
Data Collection	Sample	Treatment Arms	Main Outcomes	Pre-registration
Panel A: Green Bubble Stigma				
Mechanism Survey (Aug 2024)	Prolific ($n = 476$)	None	Android stereotypes, preferences over green bubbles, perceived quality	`https://aspredicted.org/r27m-69c8.pdf`
Panel B: The Welfare Cost of Green Bubbles				
Deactivation Exp. (Oct 2024)	College Pulse ($n = 344$)	Blue Bubbles deactivation, privacy and hassle cost control	WTA for deactivation	`https://aspredicted.org/xxyp-s8qx.pdf`
Panel C: Green Bubbles and Product Demand				
Main Demand Exp. (Nov 2024)	Prolific ($n = 468$)	Blue Bubbles, Green Bubbles treatment	Choice: iPhone 16 or Google Pixel 9 + \$150	`https://aspredicted.org/54y4-s5jj.pdf`
Robustness Exp. (Aug–Sep 2024)	College Pulse, Prolific ($n = 1,369$)	Blue Bubbles, Green Bubbles treatment	WTP: iPhone 16 Pro Max vs. Samsung Galaxy S24 Ultra	College Pulse: `https://aspredicted.org/4tp9-tvzr.pdf`, Prolific: `https://aspredicted.org/4ytf-zgwq.pdf`
Panel D: Non-User Externalities Across Product Features				
Feature Survey (Jul 2026)	Prolific ($n = 500$)	None	Preference for removal, perceived quality change for users and for the outside group, per-feature mechanism attribution	`https://aspredicted.org/pm7jv4.pdf`

Notes: This table provides an overview of all data collections used in the paper, grouped by paper section. Panel A covers the mechanism survey in Section 3.2. Panel B covers the deactivation experiment in Section 4. Panel C covers the demand experiments in Section 5. Panel D covers the feature-level survey in Section 6. Each respondent rates four of nine design choices under a random subset. The mechanism survey and robustness demand experiment had a hard cutoff on Sept 16, 2024, due to iOS 18's introduction. The main demand experiment had a hard cutoff on Dec 2, 2024, due to Cyber Monday sales ending.

G.2 Mechanism Survey

The following screenshots reproduce the full mechanism survey instrument as presented to respondents (Table A24).

Appendix Table A24: Mechanism survey screens



When you think of someone who owns an Android instead of an iPhone, what comes to mind?

Please respond in full sentences.

Are you aware that messages sent between Androids and iPhones appear as green bubbles on iPhones, while texts between iPhones appear as blue bubbles?

- Yes
- No

Participants who answer this question correctly will be entered into a draw for a **$100 bonus payment.**

According to a sample from the US, iPhone users have an average annual income of **$53,000**. Do you think the average income of **Android users** is **higher or lower** than **iPhone users** ?

- I think the average income of Android users is **higher** than iPhone users
- I think the average income of Android users is **lower** than iPhone users

Appendix Table A24: Mechanism survey screens (continued)

Participants who choose the most accurate bracket will be entered into a draw for a **$100 bonus payment.**

Please specify how much **lower** than $53,000 in US dollars you believe the average income of **Android users** is compared to **iPhone users.**

- ◯ $0-$4,999 lower
- ◯ $5,000-$9,999 lower
- ◯ $10,000-$14,999 lower
- ◯ $15,000-$19,999 lower
- ◯ $20,000-$24,999 lower
- ◯ More than $25,000 lower

Before we continue the series of questions, we will provide you with some information. Please be sure to carefully read through the information, as we might ask you questions about it later.

Texting between Androids and iPhones

Currently, texting between Androids and iPhones involves certain limitations due to **compatibility issues.**

Android users do not have access to **read receipts** or **typing indicators**, and can only send **low-quality pictures and videos** to iPhones and vice versa.

Moreover, the messages sent between Androids and iPhones appear as **green bubbles** on iPhones, while texts between iPhones appear as blue bubbles. Further, any group chats containing an Android user display green text bubbles.

Why do you think messages sent from Androids appear as green bubbles on iPhones?

Please respond in full sentences.

Appendix Table A24: Mechanism survey screens (continued)

Department of Justice (DOJ) lawsuit against Apple

The Department of Justice (DOJ) has recently filed a lawsuit against Apple. This lawsuit focuses on the **anti-competitive practices** associated with Apple's iMessage service, including the impact of the green bubbles between iPhones and Androids.

This lawsuit could result in Apple being forced to **eliminate green bubbles** and implement blue bubbles regardless of the device.

We're conducting this survey to gather information about the representative opinion of everyday users. We plan to publish a report on these findings and circulate it widely on social media and in conferences.

Previous research conducted by members of our team on policy debates, such as banning social media, has been featured in several prominent news outlets, including the Washington Post and the Financial Times.

You have the **opportunity to share your perspective on this case**. Your insights are crucial in understanding how people feel about these issues and might shape the public debate surrounding this lawsuit.

We have no agenda in this case and are simply interested in your true preferences. Your responses will remain completely **anonymous** and will be reported only in **aggregate form**.

During this survey we will be collecting your opinion for different scenarios that will be used in our report.

We will report average statistics for the different questions we ask.

The **higher** your rating of certain product features, the **higher** the average covered in the report.

Appendix Table A24: Mechanism survey screens (continued)

Will your individual responses to the questions in this survey contribute to the average in our widely circulated report on the DOJ lawsuit against Apple?

- ◯ Yes
- ◯ No

iOS 18 Update

Apple has announced that the new **iOS 18** operating system, set to be released in mid-September, will **fix most of the compatibility issues** between Androids and iPhones. Apple will use Rich Communication Service (RCS) to enable Android users to have read receipts, typing indicators and send high quality photos and videos when sending texts to iPhones and vice versa.

However, Apple has announced that messages sent between Androids and iPhones will **remain as green bubbles** on iPhones.

After the release of the iOS 18 update, most compatibility issues between iPhone and Android users will be resolved. This includes enabling Android users to see read receipts, typing indicators, and send high-quality photos and videos when texting iPhone users, and vice versa.

The only visual difference when messaging between iPhones and Androids will be the bubble color (blue versus green). Please keep this in mind as you answer the remaining questions.

Appendix Table A24: Mechanism survey screens (continued)

Imagine a scenario where after the release of the iOS 18 update, an additional messaging feature could eliminate green bubbles by making all messages, from both iPhones and Androids, appear as blue bubbles on all iPhones.

Would you want all iPhone and Android users, including yourself, to have this additional messaging feature?

Reminder: Your preferences will be included in our report and might therefore influence the public debate. Please respond truthfully.

- ◯ Yes
- ◯ No

Please explain why in full sentences.

Recall, the DOJ has sued Apple over anti-competitive practices related to iMessage's green bubbles.

We're surveying users to gather opinions that might influence the public debate through a widely circulated report.

How **likely** do you believe it is that the DOJ lawsuit against Apple will **succeed** in forcing the company to eliminate the green bubbles?

very unlikely — very likely

0 10 20 30 40 50 60 70 80 90 100

Please select a value.

Do you think that there is a social stigma against Android users whose text messages appear as green bubbles on iPhones?

- ◯ Yes
- ◯ No

Appendix Table A24: Mechanism survey screens (continued)

Please explain in full sentences why you think that.

How does **fixing the compatibility issues** of read receipts and typing indicators between Androids and iPhones **change the quality of Apple products?**

Strongly decreases quality	Decreases quality	No change in quality	Increases quality	Strongly increases quality
○	○	○	○	○

How does **fixing the compatibility issues** of read receipts and typing indicators between Androids and iPhones **change the quality of Android products?**

Strongly decreases quality	Decreases quality	No change in quality	Increases quality	Strongly increases quality
○	○	○	○	○

How does enabling messages sent from Androids to iPhones to appear as **blue bubbles change the quality of Android products?**

Strongly decreases quality	Decreases quality	No change in quality	Increases quality	Strongly increases quality
○	○	○	○	○

How does enabling messages sent from Androids to iPhones to appear as **blue bubbles change the quality of Apple products?**

Strongly decreases quality	Decreases quality	No change in quality	Increases quality	Strongly increases quality
○	○	○	○	○

Do you think that the average iPhone user is more or less attractive than the average Android user?

- ○ The average iPhone user is more attractive than the average Android user
- ○ The average iPhone user is less attractive than the average Android user

Appendix Table A24: Mechanism survey screens (continued)

How likely do you believe it is that the results of this study will be published in a major news outlet (such as the New York Times or the Washington Post)?

very unlikely ... very likely

0 10 20 30 40 50 60 70 80 90 100

Please select a value.

Recall that your answers are counting towards the average which will be featured in our report, **which we plan to widely circulate** on social media and in conferences.

How did this influence the effort you put into your responses?

- ◯ It made me put less effort into answering the questions.
- ◯ It made me put more effort into answering the questions.
- ◯ It did not affect the amount of effort I put into answering the questions.

Recall that your answers are counting towards the average which will be featured in our report, **which we plan to widely circulate** on social media and in conferences.

How did this influence how you expressed your opinions?

- ◯ It didn't affect how extremely I reported my opinions
- ◯ It made me report my opinions as more extreme
- ◯ It made me report my opinions as less extreme

G.3 Deactivation Experiment

The following screenshots reproduce the full iMessage deactivation experiment as presented to respondents (Table A25). Screens labeled "a" show the alternative branch of a randomization: the blue-bubble deactivation treatment for Option 1, and the iMessage benchmark for Option 2.

Appendix Table A25: Deactivation experiment screens

Are you primarily an Android or an iPhone user?

- ○ iPhone
- ○ I don't have a phone
- ○ Android

Do you currently have iMessage activated on your phone?

- ○ Yes
- ○ No
- ○ I don't know

We are interested in conducting an experiment where we ask participants to deactivate or keep active certain mobile phone features **for four weeks from November 4th to December 1st, 2024.**

We will compensate individuals for their participation with a monetary payment.

Should participants want to leave the study during the four weeks they can, but they will then forgo any monetary payment. To verify that participants deactivate or keep active certain features of their phone, **we will require them to upload one screenshot of their settings and may periodically send out one text per week**. **For that purpose, we would have to collect your phone number**. If you consent to participating and are selected to deactivate or keep active certain mobile phone features, College Pulse will provide us with your phone number.

If a participant fails these checks, they will not receive any monetary payment. Texts will be sent at a random time during the day once a week. It will not be at night when the participant may be asleep.

Are you willing to participate in this study?

- ○ Yes
- ○ No

Appendix Table A25: Deactivation experiment screens (continued)

This question will be used for a $100 Amazon gift card lottery for correct respondents.

How will we verify that selected users deactivate or keep active certain features? **Please select all that apply.**

☐ By periodically sending out a text message once a week.

☐ By asking them to upload one screenshot of their settings.

☐ By calling people to ask them.

This question will be used for a $100 Amazon gift card lottery for correct respondents.

For how long will we ask selected users to deactivate or keep active certain features?

◯ One week

◯ Eight weeks

◯ Four weeks

◯ Ten weeks

Before we proceed, we will give you a hypothetical example to explain how we will determine your compensation.

Suppose that we ask you to deactivate your FaceTime for four weeks.

Here's how it works:

1. We will ask you multiple questions to determine the smallest amount of money you would need to deactivate FaceTime for four weeks. We refer to this amount as your valuation below.
2. The computer will randomly generate an amount of money to offer you to deactivate FaceTime for four weeks.
3. If your valuation is lower than the computer's offer, we will ask you to deactivate FaceTime for four weeks and give you the computer's offer.
4. If your valuation is higher than the computer's offer, we will not ask you to deactivate FaceTime and you will not receive any payment in that case.

This rule means that the higher the amount you require to deactive FaceTime on your iPhone, the lower the chance that you will be chosen to be in the study and receive the computer's offer.

To make sure you get the best option for you, it is important to be **truthful** about the amount of **money** you would need to deactivate FaceTime.

Appendix Table A25: Deactivation experiment screens (continued)

We will now ask you a comprehension question based on the text above. This question will be used for a $100 Amazon gift card lottery for correct respondents.

Which of the following statements is **true** about the minimum amount of money you would require to deactivate FaceTime on your iPhone?

- ○ Requiring a higher amount of money to deactivate FaceTime makes it less likely that I will be chosen to deactivate FaceTime and receive the extra payment.
- ○ The minimum amount of money required to deactivate FaceTime does not affect the chance that I will be chosen to deactivate FaceTime.
- ○ Requiring a higher amount of money to deactivate FaceTime makes it more likely that I will be chosen to deactivate FaceTime and receive the extra payment.

Which of the following options would you prefer?

- ○ I prefer to participate in the study that involves deactivating FaceTime for the next four weeks AND receive $0
- ○ I prefer not to participate in the study that involves deactivating FaceTime for the next four weeks AND receive $0

Texting between Androids and iPhones

Texting between Androids and iPhones has historically involved certain limitations due to **compatibility issues.**

Android users did not have access to **read receipts** or **typing indicators**, and could only send **low-quality pictures and videos** to iPhones and vice versa.

Some limitations still persist today. In particular, the messages sent between Androids and iPhones appear as **green bubbles** on iPhones, while texts between iPhones appear as blue bubbles. Further, any group chats containing an Android user display green text bubbles.

Appendix Table A25: Deactivation experiment screens (continued)

This question will be used for a $100 Amazon gift card lottery for correct respondents.

Which of the following has **NOT** been a longstanding compatibility issue for texting between Androids and iPhones?

- ◯ No read receipts or typing indicators
- ◯ Low-quality pictures and videos
- ◯ Androids cannot send pictures to iPhones
- ◯ Texting between Androids and iPhones is marked by messages appearing in green bubbles on iPhones

Texting between Androids and iPhones

Apple's new **iOS 18** operating system, released on September 16th, **fixes most of the compatibility issues** between Androids and iPhones. Apple uses Rich Communication Service (RCS) to enable Android users to have read receipts, typing indicators and send high quality photos and videos when sending texts to iPhones and vice versa.

However, messages sent between Androids and iPhones will **remain as green bubbles** on iPhones.

As part of our study, we will ask you to **deactivate or keep active certain features of your phone** for four weeks in exchange for a **monetary payment**.

We will now ask you to **consider two options for the study**, one of which will be implemented for 1 out of every 10 respondents.

Appendix Table A25: Deactivation experiment screens (continued)

Option 1

The first option for the study requires **no changes to your phone** for the next four weeks.

To participate, you would simply need to upload one screenshot of your settings and receive one text message per week.

Please note that your phone would remain unchanged throughout the study.

Below is a picture of the current message display in iMessage.

Which of the following options would you prefer?

- ◯ I prefer to participate in the study for the next four weeks AND receive $0
- ◯ I prefer not to participate in the study for the next four weeks AND receive $0

Treatment-group variant (blue-bubble deactivation):

Appendix Table A25: Deactivation experiment screens (continued)

Option 1

The first option for the study involves **deactivating your blue bubbles on iMessage** for the next four weeks. During this time, your messages would **appear as green bubbles,** the **same color as standard text messages,** both to you and to others.

In this option, your messages may appear to others **as if they were sent from an Android phone.** This change would affect group conversations as well, turning the entire chat green when you send messages.

To participate, you would also need to upload one screenshot of your settings and receive one text message per week.

Please note that nothing about your phone would change except for deactivating blue bubbles.

Below is a picture that displays how messages would look like once blue bubbles are deactivated.

Which of the following options would you prefer?

- I prefer to participate in the study that involves deactivating the blue bubbles on iMessage for the next four weeks AND receive $0
- I prefer not to participate in the study that involves deactivating the blue bubbles on iMessage for the next four weeks AND receive $0

Please assess the statement below.

Unlikely ... Very likely

0 10 20 30 40 50 60 70 80 90 100

For those respondents who are chosen to get their choices implemented, how likely do you think it is that the study just described in Option 1 will be the one selected for implementation?

Appendix Table A25: Deactivation experiment screens (continued)

Option 2

The second option for the study involves adjusting your phone settings to **deactivate your phone camera** for the next four weeks.

To participate, you would also need to upload one screenshot of your settings and one screenshot of your Screen Time settings per week.

Please note that nothing about your phone would change other than your camera being turned off.

Below is a picture that shows how your settings would look like if the phone camera is deactivated.

Which of the following options would you prefer?

- ◯ I prefer to participate in the study that involves deactivating the phone camera for the next four weeks AND receive $0
- ◯ I prefer not to participate in the study that involves deactivating the phone camera for the next four weeks AND receive $0

iMessage benchmark variant:

Appendix Table A25: Deactivation experiment screens (continued)

Option 2

The second option for the study involves adjusting your phone settings to **deactivate iMessage** for the next four weeks. You would still be able to use text messaging and other messaging platforms, such as WhatsApp, Instagram, Snapchat, etc.

To participate, you would also need to upload one screenshot of your settings and receive one text message per week.

Please note that nothing about your phone would change except for deactivating iMessage.

Below is a picture that shows how RCS messages would look like once iMessage is deactivated.

Which of the following options would you prefer?

- ○ I prefer to participate in the study that involves deactivating iMessage for the next four weeks AND receive $0
- ○ I prefer not to participate in the study that involves deactivating iMessage for the next four weeks AND receive $0

Please assess the statement below.

Unlikely 0 10 20 30 40 50 60 70 80 90 100 Very likely

For those respondents who are chosen to get their choices implemented, how likely do you think it is that the study just described in Option 2 will be the one selected for implementation?

We will now ask you about the differences between the Samsung Galaxy S24 Ultra and the iPhone 16 Pro Max. Both phones are expected to be in a similar price range of $1,250.

Appendix Table A25: Deactivation experiment screens (continued)

Please compare the Galaxy S24 Ultra and the iPhone 16 Pro Max in all aspects listed below to the best of your knowledge.

	Galaxy S24 Ultra is much better	Galaxy S24 Ultra is better	They are the same	iPhone 16 Pro Max is better	iPhone 16 Pro Max is much better
Display Resolution	○	○	○	○	○
Main Camera Megapixels	○	○	○	○	○

The deactivation option that might be implemented is the **iMessage deactivation**. We will **contact you via your phone number** from College Pulse next week **if you are chosen** to participate in the deactivation for four weeks and inform you of your monetary payment for participating in the deactivation.

There currently does not exist a feature on the iPhone to change only the color of your text messages from blue to green to all users. Thank you for participating in our study. Your responses are greatly appreciated and contribute valuable insights to our research. If you have any questions or would like more information about the study, please feel free to contact us.

G.4 Main Demand Experiment

The following screenshots reproduce the full demand experiment as presented to respondents (Table A26).

Appendix Table A26: Demand experiment screens

Are you an Android or an iPhone user?

- ○ iPhone
- ○ Android
- ○ I don't have a phone

When was the last time you bought a new phone?

- ○ Within the last two years
- ○ Over two years ago

Appendix Table A26: Demand experiment screens (continued)

Are you currently considering buying a new smartphone?

- ◯ Yes, in the next 6 months
- ◯ Yes, in the next 6-12 months
- ◯ Yes, but not in the near future
- ◯ No, I am not considering it

After this survey, we will hold **a lottery** to win a smartphone!

You can choose to win an **iPhone 16 or a Google Pixel 9 and $150**. Currently, the iPhone 16 costs $800 and the Google Pixel 9 costs $650.

Both recently released, the iPhone 16 and the Google Pixel 9 are **similar in terms of overall phone quality,** including camera, battery, and display quality.

Approximately 1 out of 500 participants will win the lottery.

Here's how it works:

1. For a possible scenario, we will ask you to choose which phone you like better: the iPhone 16 or the Google Pixel 9 and $150.
2. If the future scenario occurs, the lottery will be held.
3. To make sure you get the best option for you, it is important to be **truthful** about what **choice** you like better under the scenario we describe.
4. If you win the lottery, we will ask for your zipcode and send the phone and possible cash reward to a pickup location near you (such as an Amazon Locker or PO Box). This allows you to collect the prize privately and securely at your convenience.

Which of the following statements is correct regarding how you should answer the lottery questions? This question will be used for the **$100** bonus payment.

- ◯ The choice you make influences the probability of winning the lottery.
- ◯ Since the scenario involves a future possibility, it does not matter which option you choose.
- ◯ Since the future scenario could occur, it is important to answer truthfully about which option you prefer.

Appendix Table A26: Demand experiment screens (continued)

Texting between Android and Apple Devices

Currently, SMS/MMS texting between Androids and iPhones involves certain limitations due to **compatibility issues.**

In particular, the messages sent between Androids and iPhones appear as **green bubbles** on iPhones, while texts between iPhones appear as blue bubbles. Further, any group chats containing an Android user display green text bubbles.

Before we continue the series of questions, we will provide you with some information. Please be sure to carefully read through the information, as we might ask you questions about it later.

Appendix Table A26: Demand experiment screens (continued)

Department of Justice (DOJ) lawsuit against Apple

The Department of Justice (DOJ) has recently filed a lawsuit against Apple, alleging **anti-competitive practices** related to its iMessage service. The lawsuit specifically highlights the impact of the green bubbles that appear in messages between Androids and iPhones as opposed to the blue bubbles that appear in messages between iPhones.

If successful, the lawsuit could force Apple to **remove the green bubbles** and standardize blue bubbles across all devices, regardless of the platform.

Experts anticipate that the trial is expected to begin **in the coming months**, with a decision in the case likely to follow shortly after.

According to this survey, what could Apple be forced to do because of the DOJ lawsuit? This question will be used for the **$100** bonus payment.

- ◯ Introduce a separate app exclusively for Android users to message iPhones
- ◯ Force Apple to discontinue the iMessage service entirely
- ◯ Remove green bubbles for messages between Android and Apple devices
- ◯ There is no risk of Apple being forced to make any changes

Appendix Table A26: Demand experiment screens (continued)

Now, we will ask you about your preference between receiving an iPhone 16 or a Google Pixel 9 and $150 if you win the lottery.

We will ask you for your preferred choice under a possible future scenario. If this scenario occurs, you will be entered into the lottery.

Recall that to make sure you get the best option for you, it is important to be **truthful** about what choice you like better in the scenario we describe.

Scenario: DOJ doesn't ban green bubbles

Assume that Apple loses the lawsuit in the coming months, resulting in significant fines, but **green bubbles remain**.

This means messages exchanged between Android and iPhone users would still **appear as green bubbles** on iPhones, and this would also apply to group chats, where any group containing an Android user would display green text bubbles on iPhones.

In this scenario, which of the following options would you prefer to receive?

○ iPhone 16

○ Google Pixel 9 and $150

Appendix Table A26: Demand experiment screens (continued)

How **likely** do you believe it is that the DOJ lawsuit against Apple will **succeed** in making them pay significant fines but that green bubbles will remain in the coming months?

very unlikely ... very likely

0 10 20 30 40 50 60 70 80 90 100

Please select a value.

What percent of your friends are iPhone (iOS) or Android users?

iPhone	0
Android	0
Other	0
Total	0

Assume that Apple loses the lawsuit in the coming months, resulting in significant fines for Apple but green bubbles remain.

What percent of your friends do you think would be iPhone (iOS) or Android users **one year from now**?

iPhone	0
Android	0
Other	0
Total	0

Do you usually resell your old phone?

- Yes
- No

Would you plan to resell this phone, in case you win the lottery?

- Yes
- No
- It depends on which phone I get

Appendix Table A26: Demand experiment screens (continued)

Currently, the maximum resale value* of the iPhone 16 in good condition is around $250 higher than the maximum resale value of the Google Pixel 9 in good condition.

Assume that Apple loses the lawsuit in the coming months, resulting in significant fines for Apple but green bubbles remain.

How do you think the maximum resale value of the iPhone 16 would compare to the maximum resale value of the Google Pixel 9 one year from now?

- ○ I expect the maximum resale value of the iPhone to be higher than the maximum resale value of the Google Pixel 9.
- ○ I expect the maximum resale value of the Google Pixel 9 to be higher than the maximum resale value of the iPhone.

*The claim above ($250 price difference) is based on data from Flipsy.com, a company that describes itself as follows. "Flipsy.com is the leading online pricing guide that provides accurate values for phones, tablets, gaming consoles, smart watches, books and other items. Flipsy is used by sellers to determine how much their items are worth and by buyers who are seeking fair prices."

Please specify how much higher in US dollars you believe the maximum resale value of the iPhone 16 will be compared to the Google Pixel 9 one year from now under this scenario.

$ ________

G.5 Additional Demand Experiment

The following screenshots reproduce the full iOS 18 robustness demand experiment as presented to respondents (Table A27).

Appendix Table A27: iOS 18 demand experiment screens

Are you primarily an Android or an iPhone user?

- ◯ Android
- ◯ I don't have a phone
- ◯ iPhone

Have you pre-ordered the new iPhone 16 Pro Max?

- ◯ Yes
- ◯ No

After this survey, we will hold **a lottery** to win a smartphone plus a monetary payment!

You can choose to win an **iPhone 16 Pro Max or a Galaxy S24 Ultra**. Both smartphones are in the same price range.

1 out of 200 participants will be the winner of the lottery.

Here's how it works:

1. Choose which phone you like better: the iPhone 16 Pro Max or the Galaxy S24 Ultra.
2. Next, we will ask you to choose between:

- Receiving the phone you prefer.
- Receiving the phone you do not prefer, plus extra money.

We want to know the smallest amount of extra money you would need to switch from your preferred phone to the other one.

Here's how we will decide if you win the lottery:

1. A computer will randomly pick an amount of money to offer you to switch.
2. Before we tell you the computer's offer, we will ask you the smallest amount of money you would be willing to accept.
3. If the offer is less than your amount, you will get the phone you prefer.
4. If the computer's offer is at least as high as your amount, you will get the other phone and additionally the computer's monetary offer.
5. Therefore, reporting a higher amount of money required to switch from the preferred phone to the other one decreases the likelihood of receiving the non-preferred phone and extra payment.

To make sure you get the best option for you, it is important to be **truthful** about what **phone** you like better and the **extra amount of money** you would need to switch.

Appendix Table A27: iOS 18 demand experiment screens (continued)

We will now ask you a comprehension question based on the text above. This question will be used for the **$100 bonus payment lottery**.

Which of the following statements is **true** about the minimum amount of money you would require to switch from your preferred phone to the other one?

- ◯ Reporting a higher amount of money I require to switch makes it less likely that I will get the phone I do not prefer and the extra payment.
- ◯ The minimum amount of money I require to switch does not affect the chance that I will get the phone I do not prefer and the extra payment.
- ◯ Reporting a higher amount of money I require to switch makes it more likely that I will get the phone I do not prefer and the extra payment.

Before we begin, we will go through the mechanism with a hypothetical practice question.

The following two devices are both priced around $2300. Which of the following would you prefer to receive?

- ◯ MacBook Pro (16-inch, M2 Pro)
- ◯ Lenovo ThinkPad X1 Extreme Gen 4

How much do you value getting your preferred device?

You said you prefer getting a MacBook Pro (16-inch, M2 Pro) instead of a Lenovo ThinkPad X1 Extreme Gen 4.

A computer will randomly choose an amount of money to offer you along with the Lenovo ThinkPad X1 Extreme Gen 4 to make that option more appealing. For example, you might

- still prefer a MacBook Pro (16-inch, M2 Pro) over a Lenovo Think Pad X1 Extreme Gen 4 *and $20*
- but you might prefer a Lenovo Think Pad X1 Extreme Gen 4 *and $200* over a MacBook Pro (16-inch, M2 Pro).

If the computer offers you at least the amount of money you want to switch, you will get the Lenovo ThinkPad X1 Extreme Gen 4 and the money if you win the lottery. If the computer offers you less than the amount you want, you will get the MacBook Pro (16-inch, M2 Pro) and no extra money.

What is the **smallest amount of money (in US dollars)** that would make you choose the Lenovo ThinkPad X1 Extreme Gen 4 and the money over the MacBook Pro (16-inch, M2 Pro)?

$ [ ]

Appendix Table A27: iOS 18 demand experiment screens (continued)

Did you find the way in which you were asked to state your valuation of receiving your preferred phone confusing?

- ◯ Very Confusing
- ◯ Confusing
- ◯ Slightly Confusing
- ◯ Not at all confusing

Before we ask you to choose which smartphone you like better, we will give you some information.

Please be sure to **carefully read through the information**, as we might **ask you questions** about it later for the **$100 bonus payment lottery.**

We will then ask you to choose whether you would prefer getting an iPhone 16 Pro Max or a Galaxy S24 Ultra, if you win the lottery.

Texting between Androids and iPhones

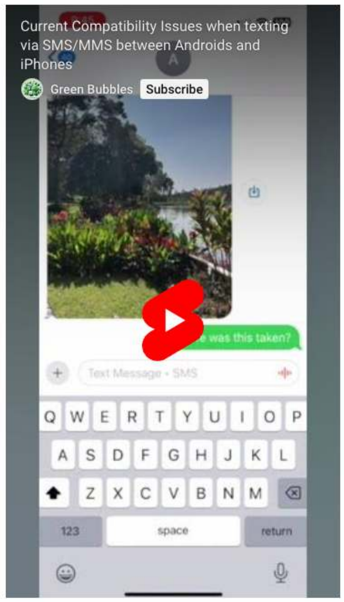
Currently, texting between Androids and iPhones involves certain limitations due to **compatibility issues.**

Android users do not have access to **read receipts** or **typing indicators**, and can only send **low-quality pictures and videos** to iPhones and vice versa.

Moreover, the messages sent between Androids and iPhones appear as **green bubbles** on iPhones, while texts between iPhones appear as blue bubbles. Further, any group chats containing an Android user display green text bubbles.

Appendix Table A27: iOS 18 demand experiment screens (continued)

Please watch the video below, which highlights the compatibility issues that occur when messaging between Androids and iPhones. We may ask you questions about it later for the **$100 Amazon gift card lottery**.



This question will be used for the **$100 bonus payment lottery**.

Which of the following is **NOT** a current compatibility issue for texting between Androids and iPhones?

- ○ Androids cannot send pictures to iPhones
- ○ Texting between Androids and iPhones is marked by messages appearing in green bubbles on iPhones
- ○ No read receipts or typing indicators
- ○ Low-quality pictures and videos

Appendix Table A27: iOS 18 demand experiment screens (continued)

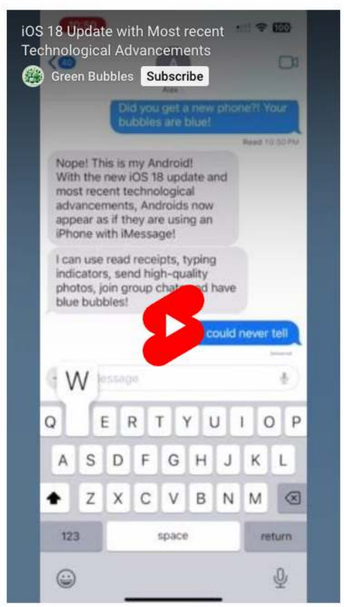
Texting between Androids and iPhones

Apple has announced that the new **iOS 18** operating system, set to be released on September 16th, will **fix most of the compatibility issues** between Androids and iPhones. Apple will use Rich Communication Service (RCS) to enable Android users to have read receipts, typing indicators and send high quality photos and videos when sending texts to iPhones and vice versa. Moreover, the most recent technological advancements further **eliminate** compatibility issues.

With these advancements, messages sent between Androids and iPhones **appear as blue bubbles**.

In this case, Android users will now appear **as if they use an iPhone** and have a more similar, seamless, and unified messaging experience when interacting with iPhones.

Please watch the demonstration video of the new iOS 18 Beta update with the most recent technological advancements below. We may ask you questions about it later for the **$100 Amazon gift card lottery**.



We will now ask you to choose which smartphone you would like to receive in case you win the lottery.

Recall, that the computer will randomy select an amount of money to offer as an extra payment to switch between phones.

To make sure you get the best option for you, it is important to be **truthful** about what **phone** you like better and the **extra amount of money** you would need to switch.

Appendix Table A27: iOS 18 demand experiment screens (continued)

The following two devices are both priced around $1250.

Please note that you will not receive the phone from the lottery until October.

Which of the following do you prefer?

- ◯ Galaxy S24 Ultra
- ◯ iPhone 16 Pro Max

How much do you value getting your preferred phone?

You said that you would prefer receiving an iPhone 16 Pro Max rather than a Galaxy S24 Ultra.

What is the **smallest amount of money (in US dollars)** that would make you choose the <u>Galaxy S24 Ultra and the money</u> over the <u>iPhone 16 Pro Max</u>?

$ [ ]

What percent of your friends are iPhone (iOS) or Android users?

iPhone	0
Android	0
Other	0
Total	0

What percent of your friends do you think will be iPhone (iOS) or Android users **one year from now**?

iPhone	0
Android	0
Other	0
Total	0

Do you usually resell your old phone?

- ◯ Yes
- ◯ No

Appendix Table A27: iOS 18 demand experiment screens (continued)

Would you plan to resell this phone, in case you win the lottery?

- ○ Yes
- ○ No
- ○ It depends on which phone I get

Currently, the maximum resale value* of the iPhone 15 Pro Max in good condition is around $150 higher than the maximum resale value of the Samsung Galaxy S24 Ultra in good condition. How do you think the maximum resale value of the iPhone 16 Pro Max will compare to the maximum resale value of the Samsung Galaxy S24 Ultra one year from now?

- ○ I expect the maximum resale value of the Samsung Galaxy S24 Ultra to be higher than the maximum resale value of the iPhone 16 Pro Max.
- ○ I expect the maximum resale value of the iPhone 16 Pro Max to be higher than the maximum resale value of the Samsung Galaxy S24 Ultra.

*The claim above ($150 price difference) is based on data from Flipsy.com, a company that describes itself as follows. "Flipsy.com is the leading online pricing guide that provides accurate values for phones, tablets, gaming consoles, smart watches, books and other items. Flipsy is used by sellers to determine how much their items are worth and by buyers who are seeking fair prices."

Please specify how much higher in US dollars you believe the maximum resale value of the iPhone 16 Pro Max will be compared to the Samsung Galaxy S24 Ultra one year from now.

$ [ ]

Thank you for participating in our study.

Note that the upcoming iOS 18 update does not eliminate green bubbles **by itself**. Recent technological advancements, such as a new app called Blue Bubbles, are needed.

The app can be downloaded using the following link: https://bluebubbles.app

Your responses are greatly appreciated and contribute valuable insights to our research. If you have any questions or would like more information about the study, please feel free to contact us.

G.6 Feature Survey

The following screenshots reproduce the feature survey as presented to respondents (Table A28). They are taken from one pass through the instrument, in which the respondent drew Bumble's match expiration, Nike's Air Jordan drops, Instagram's Stories and Apple's green bubbles.

The four loop screens are identical across features apart from the piped wording and the product image, so the table shows the loop in full for the first feature drawn and then the opening screen of each of the other three, which is where the piped wording and image differ. Appendix Table A18 states the wording for all nine features. The order of the two quality screens is randomized, implemented as two mirrored question pairs; a respondent sees exactly one pair and the pairs are identical in wording. The attention check appears once, on the third feature.

Appendix Table A28: Feature survey screens

University of Chicago
Online Consent Form for Research Participation

Study Number: IRB25-0897
Researchers: Leonardo Bursztyn, Rafael Jiménez-Durán, Christopher Roth
Collaborating Institutions: Bocconi University, University of Cologne

Description: You will be asked to fill out a short survey about your use of different products or services. Participation is voluntary and takes around 4 minutes.

Incentives: Upon completion of this survey, you will be compensated by your survey provider.

Risks and Benefits: There are no foreseeable risks associated with this study beyond those involved in everyday life. The research team cannot and does not guarantee or promise that you will receive any benefits from this study.

Appendix Table A28: Feature survey screens (continued)

Confidentiality: Confidentiality of your research records will be strictly maintained by storing any personally identifiable data in secure accounts that can only be accessed by researchers in this study. Information not containing identifiers may be used in future research or shared with other researchers without your additional consent. If you decide to withdraw, data collected up until the point of withdrawal may still be included in the analysis.

Contacts & Questions: If you have questions or concerns about the study, you can contact the researcher at bursztyn@uchicago.edu.
If you have any questions about your rights as a participant in this research, feel you have been harmed, or wish to discuss other study-related concerns with someone who is not part of the research team, you can contact the University of Chicago Social & Behavioral Sciences Institutional Review Board (IRB) Office by phone at (773) 702-2915, or by email at sbs-irb@uchicago.edu

Consent: Participation is voluntary. Refusal to participate or withdrawing from the research will involve no penalty or loss of benefits to which you might otherwise be entitled.

Appendix Table A28: Feature survey screens (continued)

By clicking "Agree" below, you confirm that you have read the consent form, are at least 18 years old, and agree to participate in the research. Please print or save a copy of this page for your records.

- I **agree** to participate in the research
- I **do NOT agree** to participate in the research. You will be directed to an exit screen.

→

Do you currently reside in the United States?

- Yes
- No

What is your age?

→

Appendix Table A28: Feature survey screens (continued)

Are you a college student?

- Yes
- No

→

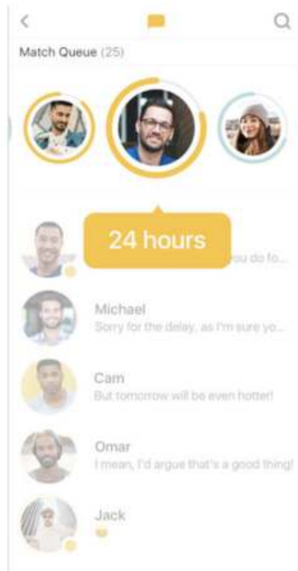
You'll see a few product features, one at a time. We'll ask you a few short questions about each.

For each product, think about how good it is for the people who use it.

→

Appendix Table A28: Feature survey screens (continued)

Feature 1 of 4: Bumble match expiration



On Bumble, a match disappears if neither person messages within 24 hours.

Which of these would you prefer?

- Bumble matches disappear if no one messages within 24 hours
- Bumble matches don't expire

→

Appendix Table A28: Feature survey screens (continued)

Feature 1 of 4: Bumble match expiration

▸ See the 24-hour match expiration details again

In your view, if Bumble removed the 24-hour match expiration, how would the quality of Bumble change for <u>occasional Bumble users</u>?

- Strongly decrease
- Decrease
- No change
- Increase
- Strongly increase

→

Appendix Table A28: Feature survey screens (continued)

Feature 1 of 4: Bumble match expiration

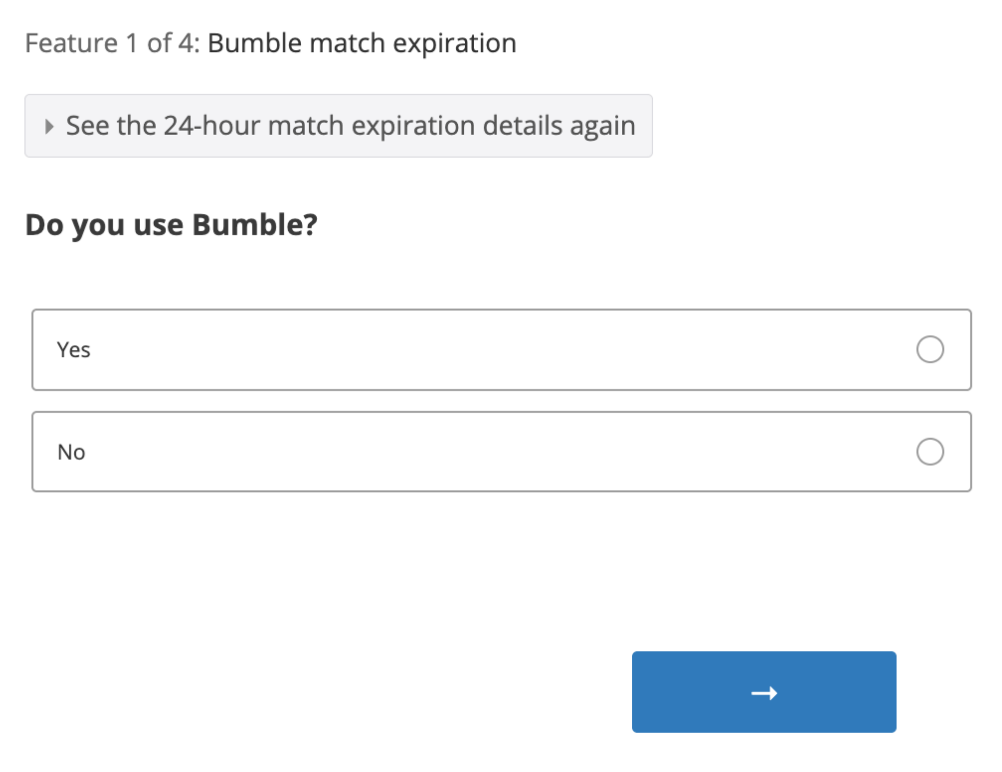
▸ See the 24-hour match expiration details again

In your view, if Bumble removed the 24-hour match expiration, how would the quality of Bumble change for <u>frequent Bumble users</u>?

- Strongly decrease
- Decrease
- No change
- Increase
- Strongly increase

→

Appendix Table A28: Feature survey screens (continued)



Feature 1 of 4: Bumble match expiration

See the 24-hour match expiration details again

Do you use Bumble?

Yes

No

→

Appendix Table A28: Feature survey screens (continued)

Feature 2 of 4: Air Jordan drops

Nike releases each Air Jordan colorway in limited quantities at a scheduled drop; pairs usually sell out within minutes and are rarely restocked.

Which of these would you prefer?

- Sold-out Air Jordan colorways are regularly restocked ○
- Sold-out Air Jordan colorways are rarely restocked ○

→

Appendix Table A28: Feature survey screens (continued)

Feature 3 of 4: Instagram Stories

Instagram Stories are photos and videos that disappear 24 hours after posting.

Which of these would you prefer?

- Instagram Stories stay up for 48 hours
- Instagram Stories disappear after 24 hours

→

Appendix Table A28: Feature survey screens (continued)

Quick attention check. Researchers include short checks like this one to verify that respondents are reading carefully. For this question only, please disregard the question text and select “Slightly disagree” from the options below.

Smartphones have made daily life more convenient.

- Strongly disagree
- Disagree
- Slightly disagree
- Neither agree nor disagree
- Slightly agree
- Agree
- Strongly agree

→

Appendix Table A28: Feature survey screens (continued)

Feature 4 of 4: iMessage green bubbles

When an iPhone user texts an Android user, the message appears in a green bubble; texts between two iPhones appear in blue. Since Apple adopted the RCS standard in 2024, these texts are technically the same; only the color differs.

Which of these would you prefer?

- iPhones show texts from Android users in green, and texts from other iPhones in blue
- iPhones show all texts in blue, whether from Android users or other iPhones

→

Appendix Table A28: Feature survey screens (continued)

Next, we'll ask one question about each feature you saw earlier.

→

Do you think Stories disappearing after 24 hours pressures occasional Instagram users to check Instagram more often?

- Yes
- No

→

Appendix Table A28: Feature survey screens (continued)

Do you think green bubbles make Android users feel lower status?

- Yes
- No

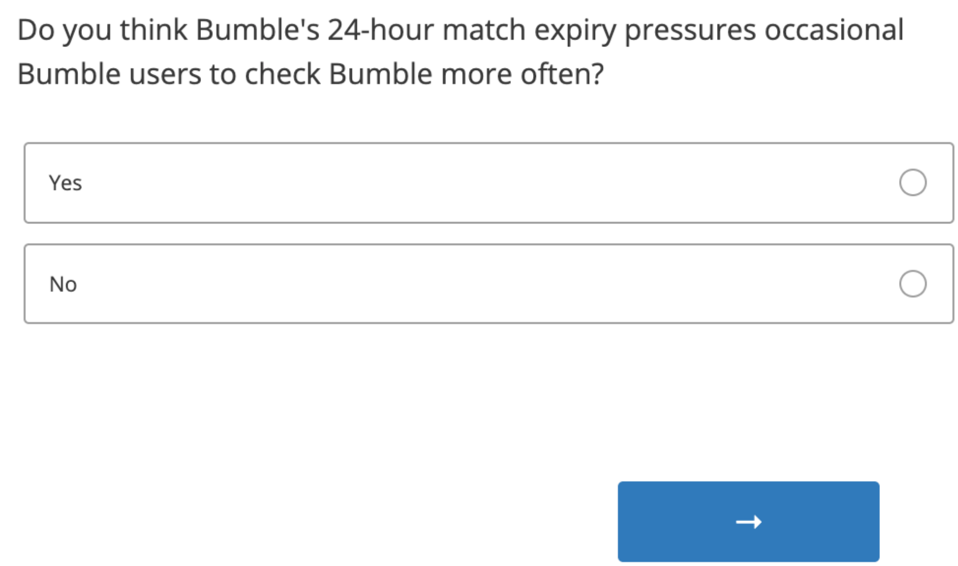
→

Do you think limited Air Jordan drops make occasional Air Jordan buyers feel lower status?

- Yes
- No

→

Appendix Table A28: Feature survey screens (continued)

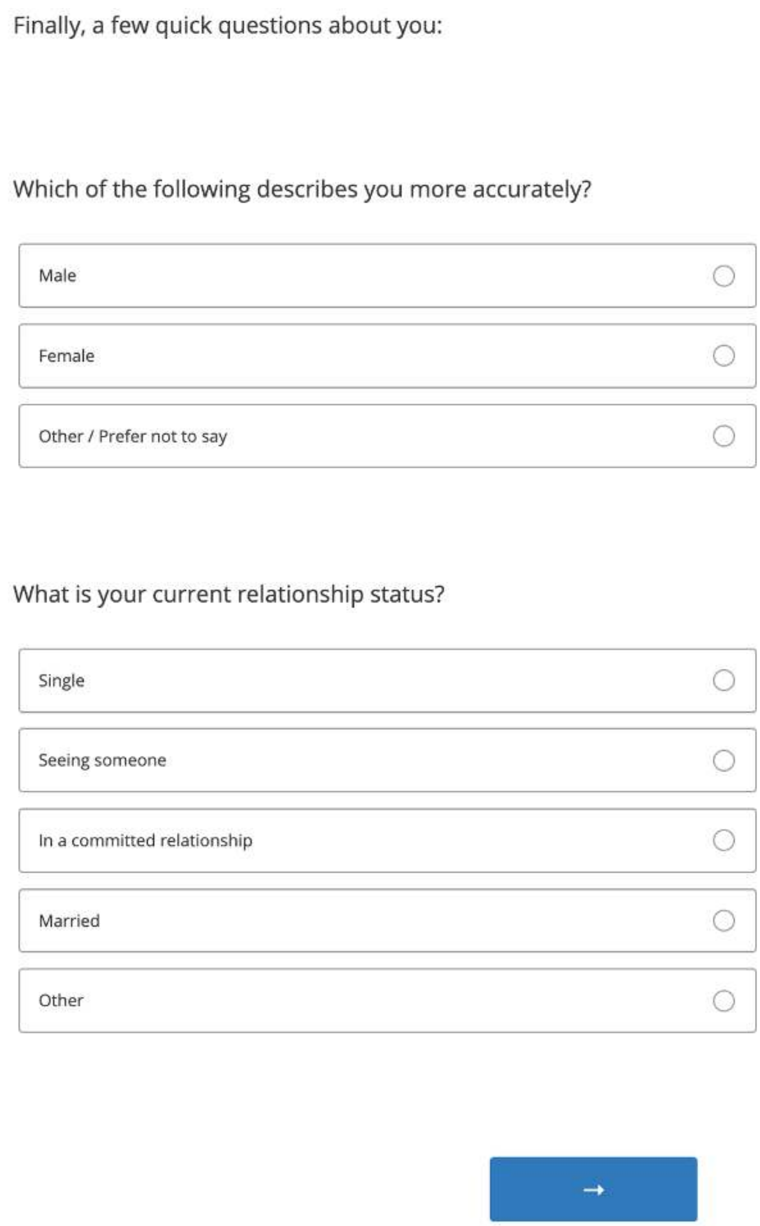


Do you think Bumble's 24-hour match expiry pressures occasional Bumble users to check Bumble more often?

Yes

No

Appendix Table A28: Feature survey screens (continued)



Finally, a few quick questions about you:

Which of the following describes you more accurately?

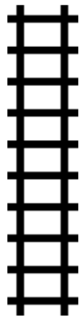
- Male
- Female
- Other / Prefer not to say

What is your current relationship status?

- Single
- Seeing someone
- In a committed relationship
- Married
- Other

→

Appendix Table A28: Feature survey screens (continued)



Think of this ladder as representing where people stand in our society.

At the top of the ladder are the people who are best off - those who have the most money, the most education and the most respected jobs. At the bottom are the people who are worst off - who have the least money, least education, and the least respected jobs or no job.

Where would you place yourself on this ladder?

- 10 (Top of ladder)
- 9
- 8
- 7
- 6
- 5
- 4
- 3
- 2
- 1 (Bottom of ladder)

→