Evaluating 'Prefer not to say' Around Sensitive Disclosures

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ABSTRACT

As people's offline and online lives become increasingly entwined, the sensitivity of personal information disclosed online is increasing. Disclosures often occur through structured disclosure fields (e.g., drop-down lists). Prior research suggests these fields may limit privacy, with non-disclosing users being presumed to be hiding undesirable information. We investigated this around HIV status disclosure in online dating apps used by men who have sex with men. Our online study asked participants ($N = 183$) to rate profiles where HIV status was either disclosed or undisclosed. We tested three designs for displaying undisclosed fields. Visibility of undisclosed fields had a significant effect on the way profiles were rated, and other profile information (e.g., ethnicity) could affect inferences that develop around undisclosed information. Our research highlights complexities around designing for non-disclosure and questions the voluntary nature of these fields. Further work is outlined to ensure disclosure control is appropriately implemented around online sensitive information disclosures.

Author Keywords

non-disclosure; disclosure; prefer not to say; structured disclosure fields; online dating; privacy; privacy unraveling; online privacy

CCS Concepts

•**Human-centered computing** → **Empirical studies in HCI;**
User studies;

1. INTRODUCTION

People are regularly asked to disclose information about themselves online through different form types, from text boxes, to drop down menus. Most widely-deployed form fields can be characterised as being unstructured, semi-structured, or structured. An example of an unstructured field is the status update feature in Facebook which asks "What's on your mind?" and allows users to input a personalised message that lacks any pre-defined structure. Semi-structured fields ask users for a particular piece of information, but allow for a personalised

response. For instance, Facebook users can add the name of their employer in a text box, even if the employer's name has not been previously defined. Structured fields differ from both the aforementioned fields as they do not allow personalised user inputs; instead they constrain disclosures to a set of pre-defined options, such as gender identity in Facebook [32].

Haimson et al. [32] highlight how using structured fields for requesting gender information can limit individualised expressions of identity by constraining users to a fixed array of choices. These fields may also limit marginalised users in engaging in what Andalibi et al. [6] refer to as "indirect disclosure". This enables a form of selective disclosure through the use of implicit cues embedded within messages. Structured fields commonly provide a non-disclosure option. Recent work suggests that this may be an ineffective means of providing users with disclosure control, as the act of non-disclosure may lead to information being inferred about an individual by other users [65], an effect known as "privacy unraveling" [50].

Whilst prior work highlights disadvantages to using structured disclosure fields, especially around sensitive information (e.g., [32]), these are in tension with some of their advantages. For instance, structured fields allow for classification of data within a system, which is more challenging around unstructured data [13]. Additionally, their constrained design can help formalise language around stigmatised identities to reduce stigma (e.g., preventing the use of the term 'clean' to refer to someone who is HIV negative [39]). Finally, the same *privacy unraveling* effect mentioned above may allow for a form of indirect disclosure when the intentionality around the effect shifts. Marginalised users who want to indirectly disclose may choose non-disclosure as a means of enabling others to infer their hidden identity [66]. Yet, whilst prior qualitative work suggests *privacy unraveling* is occurring around structured sensitive disclosure fields, this effect has yet to be explored using quantitative methods.

This paper reports on a study that helps to address this gap. Drawing on prior qualitative work [65, 66], we use the context of HIV status disclosure in sex-social apps used by men who have sex with men (MSM) to evaluate the effect undisclosed sensitive information has on how participants rate dating profiles. In doing so, we explore whether structured disclosure fields within this context are susceptible to the *privacy unraveling effect*. We designed an online user study which was deployed to $N = 183$ participants, testing different designs

for displaying (or not displaying) information fields that have been left undisclosed.

Our work provides a number of contributions to the HCI and social computing literature. We identify how undisclosed information fields can negatively affect the way profiles are rated, and that this may be more significant for minority groups. We highlight how small design changes can help to increase the effectiveness of non-disclosure options in structured disclosure fields. Finally, we discuss the implications of our work, and propose an agenda for further work in this area of research.

2. RELATED WORK

This section explores literature on privacy and self-disclosure in online social environments, *privacy unraveling*, and work on designing for non-disclosure. Throughout this section, we present research questions to address gaps in the literature.

2.1 Social Privacy and Disclosure Management Online

Prior to the advent of online social networks, people's networks were much smaller, often limited to family, close friends and colleagues [22]. Moreover, it was easier for people to control the privacy of personal information. As such, much of the early work on understanding privacy was centred around the concept of *control* (e.g., [67, 27]). As technology allowed people to share information with large networks of connections around the world, questions of privacy surfaced. Extensive research was conducted to understand how people perceived privacy and disclosure online, with much of this work drawing on the concept of control to understand people's privacy and disclosure behaviours [1, 34, 69, 38]. Yet, the nature of modern communication networks makes absolute control an almost impossible task [3]. People regularly share very personal information about themselves to large networks of connections, unable to control how it may be copied and shared with others, whilst still expecting privacy.

Online social networking platforms often merge or 'collapse' different contexts, making it difficult for people to maintain privacy between contextual boundaries (e.g., between family and work colleagues on Facebook) [42]. However, for many, these platforms play an integral role in supporting relationships and communities, and so must find ways to manage these issues of context collapse. Looking first at how people manage selective disclosures in offline environments, Clair et al. [19] developed a model of invisible identity management in offline workplaces which includes a self-disclosure strategy referred to as 'signalling'. This strategy involves the dropping of hints to 'signal' an invisible aspect of identity. For example, a person may wear a cross or carry prayer beads to signal their religious beliefs, or use verbal or symbolic hints (e.g., leaving HIV awareness pamphlets on a coffee table to 'signal' their HIV status [58, 59]). Often these cues are subtle and ambiguous, limiting disclosure to those who are able to interpret these cues. Moving to the online space, Boyd and Marwick [14] refer to a similar behaviour as 'social stenography', describing the concealing of a message within a message. In recent years, researchers have explored forms of subtle or indirect disclosure around sensitive information in various online contexts, from pregnancy loss [6], to relationship breakups [31]. These

behaviours provide a means of managing privacy within these context collapsed online spaces, not with the intention of maintaining absolute control, but to maintain what Nissenbaum [47] refers to as 'appropriate information flow'.

Nissenbaum [47] suggests that instead of information flows being subject to rigid controls, they should adhere to a set of expectations and norms, or 'transmission principles'. Privacy is then considered to be violated if information flows in a way that is deemed inappropriate by the information sender. This is an important distinction, as it allows people to engage in online communities through the act of sharing, whilst maintaining their need for self-determination to shape and manage the narrative of their online identities [16]. If a person decides against disclosing some personal information about themselves online, contextual integrity theory [47] suggests the need for this choice to be respected. Yet, if non-disclosures "leak" information through socially developed inferences around the decision not to disclose, this could violate a person's privacy.

2.2 When Privacy Unravels

Akerlof [2] showed the importance of revealing honest information in economic markets, as the value of an entire market can reduce where information asymmetry exists between buyers and sellers. Signalling, where one party reveals information to another, was proposed to reduce information asymmetry [61], with researchers (e.g., [29, 44]) showing that the absence of signalled information is presumed to be unfavourable when the cost of signalling is low and when others have an incentive to reveal. Within a dating context, a lack of signalled information may reduce the desirability of a profile.

Peppet [50] describes this game-theoretic *privacy unraveling* effect and its potential impact on privacy in relation to unilateral voluntary disclosures. Privacy unraveling threatens the voluntary aspect of disclosure in certain environments as it can lead to all parties revealing to avoid being perceived to be holding unfavourable information. For instance, in a labour market where workers can optionally self-report their own productivity, those with the highest productivity (high types) have an incentive to reveal, while workers with average productivity (medium types) may also reveal to differentiate themselves from workers with a lower than average productivity. This continues, unraveling down to the least productive workers (low types) who then have no incentive to reveal [9].

Empirical studies have explored the effect of *privacy unraveling* in different markets, from labour markets [9, 26] to online internet auction websites [40]. Much of this work focuses on the disclosure side of unraveling, exploring how disclosure increases throughout the market to maintain individual desirability. Less work has explored privacy unraveling from a perceptions perspective. The limited research on perceptions found that where feedback was received on previous transactions, the effect of *privacy unraveling* was reduced. Ma et al. [41] explored the relationship between information disclosure of Airbnb hosts and their perceived trustworthiness, finding a reduction in information disclosed correlated with reduced trustworthiness. Recent research found concerns developing around HIV status information in sex-social apps used by MSM [65], whilst also identifying how this effect

allows users to indirectly disclose their HIV status [66]. However, their work was based on qualitative methods and may not generalise to a wider demographic. In the quantitative studies discussed, the framing is around economic markets, and so the findings may not transfer to social contexts due to different incentives that exist around disclosure. As such, we build on prior quantitative and qualitative research by investigating the following research question:

RQ1: *Do undisclosed HIV status fields affect the desirability of profiles?*

2.3 Designing for Non-disclosure
Thinking and research around designing for non-disclosure is only just starting to emerge. Peppet [50] identified a number of ways in which the effect of *privacy unraveling* could be limited, with these limitations being conceptualised in various different designs around HIV disclosure in a dating context [65]. Governments have also started engaging with this issue, with the UK government considering and evaluating different non-disclosure design options around sensitive information such as gender for the 2021 housing and population census [28]. In the US, many states have adopted "ban the box" policies which prevent employers from asking about criminal records on job application forms. Whilst this was intended to help those with convictions secure work, it had an undesired and unintended effect of causing minority groups to be further disadvantaged. The absence of criminal information caused other information (e.g., age, ethnicity) to be used to infer a candidate's past criminal behaviour [21].

Where information could be used to stigmatise and discriminate, one approach could be to suppress it. However, unintended consequences of this approach may disadvantage a wider set of users, as was observed in the "ban the box" example above. Another approach is to provide users with disclosure choice, yet this too has limitations due to the *privacy unraveling* effect.

When thinking about non-disclosure in the context of online social platforms, we consider the visibility of undisclosed information fields. In today's sex-social apps used by MSM, information fields that have not been disclosed are mostly hidden from a user's profile, meaning when a user decides not to disclose information (e.g., HIV status), the field is no longer visible on their profile. Yet, other social networks maintain the visibility of this information by displaying the field with a "prefer not to disclose" or similar label. Therefore, we look to address the following research question:

RQ2: *Does the visibility of undisclosed information fields affect the desirability of profiles?*

The concept of ambiguity is often discussed in relation to privacy and disclosure. Above we discussed work that explored indirect forms of disclosure which rely on a level of ambiguity being developed into communications [6, 43, 31]. Therefore, ambiguity can be a resource when self-disclosing, which provides a level of "soft" boundary control [53]. Ambiguity is a concept used in face-to-face communication which can help

harmonise interactions where social difficulties occur, such as unexplained unresponsiveness [7]. For instance, Alex may miss and not return Billy's call. The ambiguity around why Alex did not return the call allows Alex to develop a story (an excuse) to tell to Billy when they meet, with this same ambiguity allowing Billy to accept Alex's story. If Billy was to have perfect information about Alex (i.e., know everything about them), the harmony within the interaction may break down. However, less information does not necessarily mean greater levels of ambiguity, instead it reduces the constraints around which a story can be shaped [12].

Designers have developed ambiguity into HIV disclosure fields using an "Ask Me" placeholder for information fields that have not been disclosed by users. Past research has explored this "Ask Me" non-disclosure design, finding that the increased ambiguity that these fields create reduces the amount of engagement a profile receives [33]. This research explores the impact an ambiguous response has on the way profiles are rated by asking the following research question:

RQ3: *Do ambiguous undisclosed information fields affect the desirability of profiles?*

2.4 Social Norms Around Disclosure
Well established interpersonal theories such as social penetration theory [4], and uncertainty reduction theory [10] suggest that self-disclosures occur as a way for individuals to make themselves known to each other. According to these theories, people engage in reciprocal pairwise interpersonal interactions to increase the breadth and depth of information known about one another, reducing uncertainty between conversation partners. Yet, Andalibi and Forte's [5] theory of *network-level reciprocal disclosure* suggests reciprocity extends beyond pairwise interactions, with observations of other people's disclosures of stigmatised information within a network acting to motivate further self-disclosures of others. Moreover, learning the norms around disclosure within an online environment may also encourage disclosure [62]. If these same norms and network-level reciprocal disclosure behaviours also affect how people perceive undisclosed information, those not disclosing in high frequency disclosure environments may be more likely to be assumed to be hiding some unfavourable information. Therefore, this study investigates the final research question:

RQ4: *Do social disclosure norms within an online environment affect the desirability of profiles?*

3. CONTEXTUAL BACKGROUND
This section provides an overview of the background literature related to this study's context. We first provide an overview of HIV, highlighting some significant changes that have occurred around the virus in recent years. We then explore prior literature on both offline and online HIV disclosure behaviours.

3.1 Human Immunodeficiency Virus (HIV)
HIV is a virus that, in many areas of the world, disproportionately affects the MSM community [18], with many areas in the western world reporting sexual intercourse as being the most common means of transmission (e.g., UK [46]). Although

HIV is a life threatening condition, highly active antiretroviral therapy (HAART) can increase life expectancy of people living with HIV to the same as the general population if people are diagnosed early and on effective treatment. HAART can often suppress the virus to an *undetectable* level, at which point the risk of onward transmission through unprotected sexual intercourse is zero [56, 57]. Together with treatment options, some antiretroviral drugs are being given to people at high-risk of HIV, as a primary prevention method to prevent the virus from becoming established in a person's system in the event of exposure. Known as pre-exposure prophylaxis (PrEP), there is an increased prevalence in self-reported use of these drugs in the US and worldwide [37]. A worldwide initiative known as 90:90:90 [49] aims to ensure that 90% of people living with HIV know their status, that 90% of these are accessing treatment and 90% have a suppressed viral loads. Treatment and prevention options have created various statuses that someone may identify as. These statuses are summarised in Table 1.

Table 1: Summary of the different HIV status options

HIV Status	Description
Unknown	Not recently tested for HIV and unaware of their status.
HIV Negative	Tested negative; however, those who are untested may also identify with this status.
Negative, on PrEP	Tested negative and taking PrEP.
HIV Positive	Diagnosed as HIV positive with a detectable viral load.
Undetectable	Diagnosed as HIV positive on effective treatment with an undetectable viral load.

Although HIV is now a treatable chronic condition, there is still a significant amount of stigma around the condition [60]. This can make it difficult for MSM diagnosed with HIV to disclose and discuss their HIV status to others.

3.2 Disclosure of HIV Status Information

Disclosure of any stigmatised condition is an important step in achieving social support [54]. Yet, due to the highly stigmatised nature of HIV, disclosure of a positive HIV status can be challenging. In face-to-face scenarios, disclosure is linked to the levels of stigma experienced in a particular community. People living with HIV tend to engage in selective disclosure. That is, they evaluate whether the target of disclosure may propagate their secret to others [64], or if they may experience social rejection [68]. Thus, their disclosures are controlled (e.g., doing it anonymously, travelling to other far locations) and often occur with trusted romantic partners and family members, as well as with health care providers who are bound to protect their privacy and confidentiality rather than with casual friends [64]. Apart from issues related to privacy and propagation of disclosed information, Peterson [52] found that women living with HIV are also very selective about who they disclose their HIV status to because of the dilemma they face when disclosing. On one hand, disclosure may activate social support, but on the other hand, the disclosure could affect the relationship with the recipient in a negative way by imposing onto them an emotional burden.

In some online settings, people living with HIV exert less control over their HIV status disclosure due to perception of increased anonymity and the associated privacy that this anonymity affords them [17, 54]. Additionally, some people living with HIV disclose their status online to help normalise HIV and reduce public stigma [66]. Although disclosure does have health benefits for people living with HIV via the activation of social support in online settings (e.g., [66, 45, 20, 51, 55]), people living with HIV are less likely to disclose their status, and often misreport their status to prospective sexual partners [17, 66]. In this sense, people living with HIV are still engaging in selective disclosure in online settings, especially if such interactions could lead to face-to-face encounters where social rejection may occur.

4. METHOD

We conducted an online study to investigate the effect of *privacy unraveling*, drawing on prior work to develop our context of study [65, 66]. We test this effect around HIV status information in sex-social apps used by MSM. We used a 3 x 2 x 4 mixed factorial design to determine the effects of the between-subject variables *Interface Design* (Visible vs. Hidden vs. Ask Me) and *Social Disclosure Norms* (High Social Disclosure Norms vs. Low Social Disclosure Norms); and within-subject variables *HIV Status* (Negative vs. Negative on PrEP vs. Positive, Undetectable vs. Undisclosed). Participants were asked to participate in our study using their mobile phone's Internet browser to simulate the experience of using a mobile phone based app.

4.1 Study Variables

4.1.1 Dependent variable

We indirectly tested the central construct of *privacy unraveling* by asking participants to rate profiles on a 5-star rating scale in response to the following question: *"How interested are you in me?"*. This rating was designed to ascertain how desirable each profile was to participants. Each participant was asked to rate a number of profile pairs, with HIV status information disclosed in one of the paired profiles and undisclosed in the other. Other profile information (e.g., age, ethnicity) was kept constant. Names between paired profiles were changed to avoid participants recognising that profiles were being repeated (e.g., Mike becomes Matt).

We used an indirect testing method to test the *privacy unraveling* construct to avoid directly asking participants what they perceived the HIV status of a profile to be. We did this for a number of reasons. Firstly, we wanted to avoid the question itself acting as a cue. Secondly, we wanted to understand not only the conscious choices of participants, but also the unconscious choices which may be subject to implicit bias [39]. Lastly, in the ethical deliberation of this study in collaboration with the third author, a sexual health and HIV physician, we felt it unethical to ask participants to infer the HIV status of a profile as this could influence the way participants evaluated real dating profiles, creating an environment of suspicion.
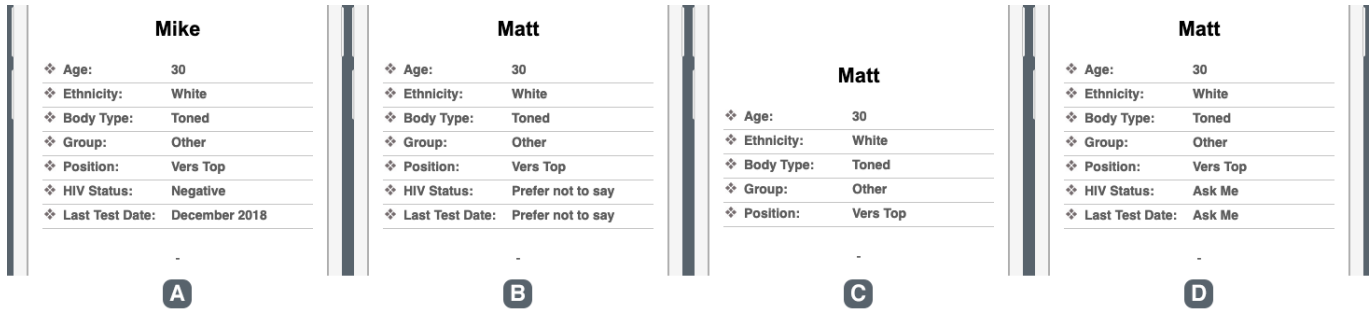
Figure 1: Example of a disclosing profile, and a profile under three different non-disclosure design conditions.

Whilst most dating apps do not provide users with an absolute preference system (i.e., they do not ask users to rate profiles), a form of cognitive rating is likely to occur in the decision-making and in the selection process. However, absolute preferences have limitations. For instance, it can be difficult to calibrate between and within participants [30]. E.g., one person may score higher on average than another or may be inconsistent in their judgement, rating items differently as their knowledge of the entire set grows. Our study compensated for calibration limitations by asking participants to rate an initial set of profiles before rating the two test profile sets.

Independent (between-subject) variables
We tested the effect undisclosed HIV status information had on profile ratings under three interface design conditions. The *Visible* design explicitly informed participants when HIV status information was undisclosed (see: Fig 1b), whilst the *Hidden* design condition removed the HIV status field from the profile when undisclosed (see: Fig 1c). This allowed us to understand how the visibility of undisclosed information impacted profile ratings. For the last design condition, we implemented a purposefully ambiguous *Ask Me* design (see: Fig 1d) to understand how ambiguity affected profile ratings. We also tested the effect undisclosed HIV status information had on profile ratings under two social disclosure norm conditions. The *High Social Disclosure Norms* condition exposed participants to profiles that disclosed HIV status information ~65% of the time. The *Low Social Disclosure Norms* condition exposed participants to profiles that disclosed HIV status information ~40% of the time. We manipulated disclosure norms by priming participants with a set of profiles (see: Section 4.4).

Independent (within-subject) variables
The independent within-subject variables were: Negative, Negative on PrEP, Positive Undetectable, and HIV Status Undisclosed. To compute these variables, we used the means of ratings across the two sets of test profiles (see: Table 2). We used two sets of profiles in order to control for other profile information (e.g., age, ethnicity) (see: Step 3 below).

Effective treatment, together with the worldwide 90:90:90 initiative are now making it a much less common for someone living with HIV to be detectable. As such, we did not include HIV positive (detectable) as a variable in our study.

Table 2: Distribution of profiles disclosing HIV status in the prime high and low sets, and test sets A and B.

	Prime High	Prime Low	Test Set A	Test Set B
Total profiles	15	15	12	12
Negative	6	2	2	2
Negative PrEP	6	1	2	2
Pos Undetectable	1	1	2	2
Undisclosed	2	11	6	6

4.2 Participant Recruitment

We performed a priori power analysis to estimate sample size. This resulted in a recommended sample size of 171 for within-between subjects interaction effect (when $\alpha = 0.05, 1 - \beta = 0.8, f = 0.1$). Participants were recruited via the academic participant recruitment platform Prolific [1]. Recruiting via this platform allowed us to compensate participates for their time (UK living wage of £8.21 per hour). It also limited the amount of personal information we collected from participants whilst providing us with an easier to reach pool of participants. Finally, it allowed us to screen for participants who met our inclusion criteria. All participants had to meet the inclusion criteria of being: (1) male, (2) over the age of 18, (3) interested in having sex with men (4) and those who have used a sex-social app. We targeted men who have used a sex-social app as they will have experience of these apps, and are likely to be in a dating mindset. Participants were mostly young (under 24 (28.9%), 24-34 (50.3%)), mostly White (77.5%) and from Europe (62.3%) or North America (30.6%). Reflective of our population (e.g., in UK, 7.7% of MSM aged 15 to 59 living with HIV [15]) most reported being HIV Negative (86.1%).

4.3 Data Collection

The study was conducted online from 8 - 11 March 2019. Participants took on average 7.83 minutes to complete the study. In total, we received 235 responses, of these, 43 failed study attention checks and were removed from the sample, five were removed due to being incomplete and a further four outliers were removed.
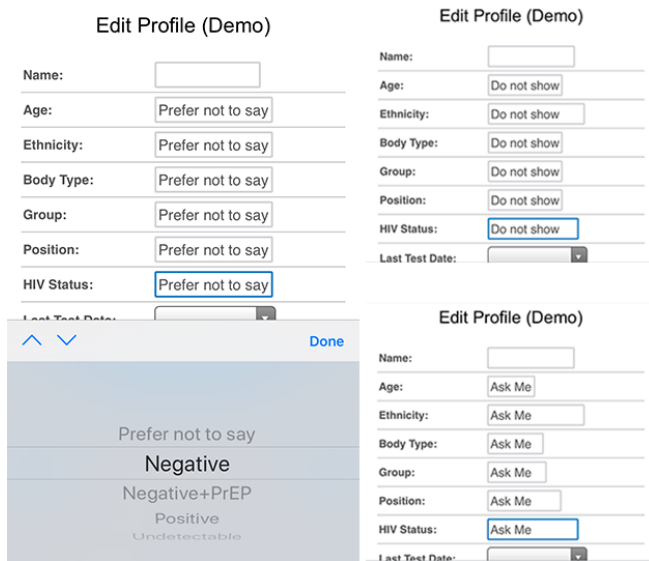
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[1] https://www.prolific.ac

Figure 2: Screenshots of the edit profile screens shown to participants before they start the profile rating task.

4.4 Experiment Overview

This section provides an overview of the four steps of our online study: familiarisation, rating priming set, rating test sets, and manipulation checks and an exit demographics survey.

Step 1. Environment Familiarisation

The framing of questions has an effect on disclosure decision-making [36]. Fields that are designed with a default non-disclosure option are referred to as passive non-disclosures as users are not required to act in order to keep their information undisclosed. In contrast, active non-disclosures require users to explicitly select a non-disclosure option. To align the study to existing HIV status disclosure fields, a passive non-disclosure design was used. Users were primed on the default option by providing them with a demo *edit profile* screen (see: Fig 2) to interact with before rating any profiles.

Step 2. Rating of Social Disclosure Norm Priming Set

Before being presented with the test profiles, participants were randomly assigned to either the *High or Low Social Disclosure Norm* condition. Participants were primed by asking them to rate an initial set of 15 randomly ordered priming profiles. The distribution of these two priming sets is detailed in Table 2.

Step 3. Rating of Paired Profile Test Sets

Participants were randomly assigned to one of the three interface design conditions (*Visible vs. Hidden vs. Ask Me*) and asked to rate 24 randomly ordered test profiles. To control for other profile information (e.g., age, ethnicity), participants rated the same profile twice. To make the paired profiles appear unique, the names on the profiles were changed (e.g., Mike becomes Matt). HIV status information across the profile pairs was the only other change made, with one profile in each pair disclosing HIV status information, and the other keeping HIV status information undisclosed. Fig 1 is an example of a profile set, and Table 2 shows the distribution of disclosed/undisclosed profiles in each set.

Step 4. Manipulation check and survey

We integrated two types of checks at the end of the study. The first was a simple attention check question. The second asked participants to respond to the following 5-point Likert scale question: *"How often do you think the profiles you just rated disclosed HIV status information?"*. Responses to this question were analysed to ascertain the effectiveness of the disclosure norm manipulation.

As we wanted to ensure the disclosure norm prime was still effective at the end of the study, the manipulation check was placed after all profiles had been rated. The responses ranged from 1 (Never) to 5 (Always). We applied independent samples t-Test to identify whether the manipulation was effective. The results showed a significant difference in responses between the respondents from *High* ($M = 3.59, SD = .683$) and *Low* ($M = 2.39, SD = .513$) social disclosure norm groups, $t(181) = -13.478, p < .001$. Participants exposed to the *Low* disclosure norm manipulation group scored minimum of 1 and maximum 3. Respondents from the *High* disclosure norm group scored minimum 3 and maximum 5. Therefore, we determine that the manipulation was effective, and included the priming variable in further statistical analysis. Finally, participants were asked a series of demographic questions.

4.5 Pilot Testing and Profile Design

In the process of developing this study we were faced with a number of decisions in relation to the design of the test profiles. In this section we first present an overview of the pilot studies conducted, and then discuss the different design elements considered, and the rationale for the decisions made.

4.5.1 Pilot Studies

We performed a series of pilot studies during the development of this study. After each pilot, issues identified that were likely to affect the study were corrected, and the updated design tested in further pilots. Multiple pilot studies were conducted during study development. These were (1) paper based, (2) think-alouds.

An initial paper pilot study was conducted with MSM who used sex-social apps ($N = 3$). Participants were shown a series of mock dating profiles, sample questions (e.g., *"Would you be interested in me?"*), and different scale response designs (e.g., 5-star rating, slider style rating). This stage of the pilot study was designed to elicit feedback on the visual designs of the mock profiles, the information attributes included in the profiles (e.g., age, ethnicity), the interpretation of different questions to gauge profile rating, and the design of the rating system. The second stage of piloting involved lab-based think-alouds with both MSM who used sex-social apps, as well as non-MSM who were provided personas ($N = 7$). Participants were asked to think aloud whilst performing the study task on their own or a lab mobile phone. Participants were asked to comment on what they were looking at, thinking about, doing, and feeling in relation to each stage of the study.

4.5.2 Exclusion of Profile Pictures

Previous studies have found profile images having a significant impact on the way people develop judgements of others, and typically outweigh other visual cues such as text in a biography [48]. Men appear to be more susceptible to influence than women, with one study finding that even when men are informed that images being viewed on dating profiles were fake and not representative of the profile owner, the profile pictures still had a significant impact on judgement formation [8]. To control for profile picture, we would have had to use the same profile picture across each profile pair which would have increased the risk of participants becoming aware that they were rating paired profiles and so we excluded profile pictures from the study. During piloting participants highlighted the lack of profile pictures and so we informed participants that, for the purposes of this study, profiles would not contain pictures.

4.5.3 Profile Layout

This study explored the effect non-disclosure interface design factors have on profile ratings. The *Hidden* design removes undisclosed fields from view (see: Fig: 1c). When the field is removed it leaves an empty space which may act as a non-disclosure cue. Therefore, we tested two different layouts, moving the white space to (1) the top, and (2) the bottom of the profile. Our pilot studies found that, whilst the non-disclosure cue could not be completely eliminated, placing the white space at the top (see: Fig 1c) reduced the effect of white space as a cue. We therefore developed our hidden cue design with spacing placed at the top of the profile.

4.5.4 Profile Information

To select the type of information being presented on profiles, we evaluated three popular MSM dating apps (i.e., Grindr, Scruff, Hornet), and selected information attributes (e.g., ethnicity, position) consistent across all. We evaluated this information in pilots to ensure enough information was available to participants for them to state their preference. Profile names were selected from a number of popular US/UK/Worldwide name lists [2]. Finally, the first and third author who are familiar with these dating apps collaboratively populated a data set of test profiles. In pilot tests, participants were asked questions about the profile information to assess its credibility. Iterative adjustments were made based on this feedback.

4.6 Consent and Ethics

Participants were informed that the research was being conducted by a team of UCL researchers conducting a study into the usability of online dating apps, and were provided an online consent form. At the end of the survey, participants were asked for optional anonymous demographic information (e.g., age, gender, ethnicity), as well as their HIV status (i.e., Positive, Undetectable, Negative, Negative on PrEP) and regularity of testing. This study followed the GDPR data minimisation principles [3] ensuring no data was being collected unnecessarily, and where possible the data was collected anonymously. As our research is interested in how undisclosed information affects how people evaluated dating profiles, informing them

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[2] e.g., https://www.babycenter.com
[3] Article 5(1)(c) of the General Data Protection Regulation (GDPR)

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of the true purpose of the study may have introduced certain biases (e.g., social desirability/confirmation bias). Therefore, we used mild deception. Our own ethical considerations in collaboration with the third author who is a sexual health and HIV physician, and those of our institutional ethical review board found it unlikely that this would result in any harm or distress to participants. Our study protocol was approved by the UCL ethics board, reference number: 11699/004.

4.7 Analysis

We used a mixed design repeated measures ANOVA to analyse the data. Mixed design is a method that incorporates two or more predictor variables of which at least one has been manipulated using different participants, and one or more has been manipulated using the same participants [25].

To use the mixed design we first screened the data and checked the test's assumptions. The data screening process resulted in the identification of four significant outliers: one univariate and three multivariate outliers (identified with Mahalanobis distance [63]). After removing outliers, we checked the remaining assumptions. The data was approximately normally distributed, with slight violations to normality. However, mixed ANOVA is robust against violation of normality so we proceeded with analysis [25]. The Box's test for equality of covariance matrices was non significant ($p > .05$) confirming that the covariance matrices of the dependent variables are equal across groups. Lastly, we checked sphericity (assumption that the variances of the differences between different treatments are equal). We used Mauchly's test which was significant for HIV status (4 levels) with Greenhouse-Geisser $\varepsilon > .75$, violating the assumption. Hence, we report Huynh-Feldt corrected degrees of freedom of the F ratio [25].

5. RESULTS

To address the research questions we applied a statistical analysis, a mixed design repeated measures ANOVA. There were two between subject factors: interface design condition (*Visible N = 61*, *Hidden N = 61* and *Ask Me N = 61*) and social disclosure norm condition (*Low Social Disclosure Norms N = 92*, *High Social Disclosure Norms N = 91*).

To answer RQ1 we investigated the within-subject Huynh-Feldt corrected test result, which shows a significant overall effect of HIV status on profile ratings, $F(2.461, 435.544) = 132.426$, $p < .001$, $\eta^2 = .428$. The effect of HIV status on the profile ratings shows that Positive, Undetectable profiles were rated lower than all other profiles. Undisclosed profiles were rated higher than Positive, Undetectable profiles, but lower then both HIV Negative, and HIV Negative, on PrEP profiles.

5.1 Interface Design

To answer RQ2 and RQ3 we looked at within-subject results for the three interface design conditions. Our findings show a significant interaction effect between HIV status disclosure and the interface design conditions, $F(4.921, 435.544) = 2.841$, $p = .016$, $\eta^2 = .031$. The results of the interaction effect are presented in Fig 3.
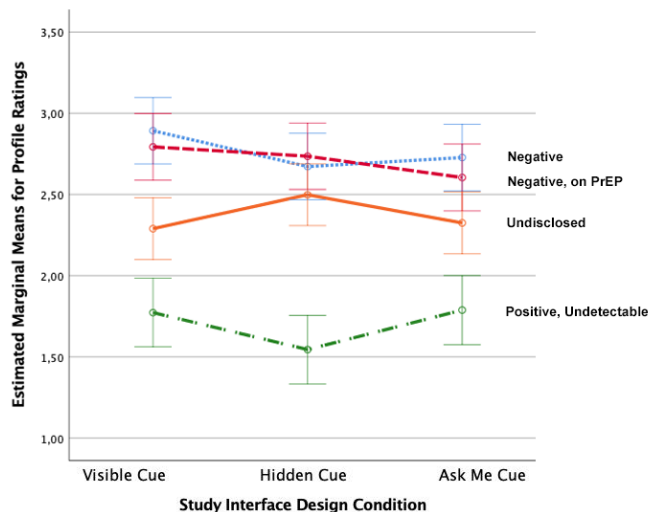
Figure 3: Estimated means of profile ratings between design groups. Error bars: CI 95%.
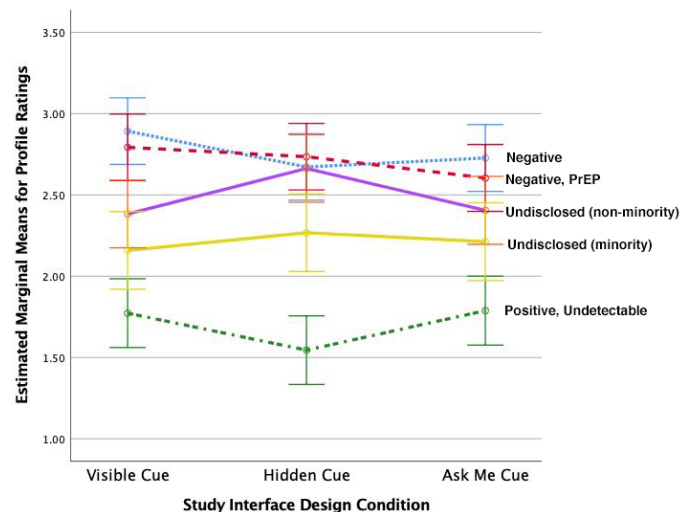

Figure 4: Estimated means of profile ratings between design groups with undisclosed variable split into undisclosed (minority) and undisclosed (non-minority). Error bars: CI 95%.

To identify which within-subject ratings significantly differed we investigated simple effects. Specifically, we applied pairwise comparisons with Bonferroni correction, to control for familywise error rate. The overall results of simple effects are presented in Table 3.

Visibility of Undisclosed Information Fields (RQ2)
In the *Visible* condition there was a significant difference between means of Undisclosed ratings against Negative ($p < .001$), Negative, on PrEP ($p < .001$), and Positive, Undetectable ($p < .001$) ratings. The means of Positive, Undetectable ratings also differed significantly from the means of Negative ($p < .001$), and Negative, on PrEP ($p < .001$) ratings. However, there was no statistically significant difference between Negative and Negative on PrEP means.

Similarly to the above, in the *Hidden* condition there was a significant difference between the means of Positive, Undetectable ratings against Negative ($p < .001$), Negative on PrEP ($p < .001$) and Undisclosed ($p < .001$) ratings. However, unlike in the *Visible* condition, the means of Undisclosed ratings were not statistically significantly different from the means of Negative and Negative on PrEP ($p > .05$) when the undisclosed information field was hidden.

Ambiguous Information Fields (RQ3)
In the ambiguous *Ask Me* condition we observed similar findings to those in the *Visible* condition. There was a significant difference between means of Undisclosed ratings against Negative ($p < .001$), Negative, on PrEP ($p = .022$), and Positive, Undetectable ($p < .001$) ratings. The means of Positive, Undetectable ratings also differed significantly from the means of Negative ($p < .001$), and Negative, on PrEP ($p < .001$) ratings. However, there was no significant difference between the means of Negative and Negative, on PrEP ratings.

5.2 Social Disclosure Norms (RQ4)
We investigated whether social disclosure norms affect perceptions of HIV status non-disclosures. We found no significant

interactions between the social disclosure norm conditions ($p > .05$). Moreover, the statistical analysis did not identify significant between-subject effects for different design conditions and social disclosure norm conditions ($p > .05$).

5.3 Additional Analysis
Additional analysis was conducted to understand whether the ethnicity reported on the dating profiles had an effect on how the undisclosed profiles were rated. The repeated measures ANOVA was re-run, splitting the HIV Undisclosed variable into two (non-minority, minority). Over 77% of the participants of this study reported an ethnicity of 'White', making this the majority ethnicity. We used this figure to define our two variables of non-minority and minority. To compute them, we calculated the mean ratings for undisclosed profiles that reported their ethnicity as 'White' to create the Undisclosed (non-minority) variable and the mean rating of all other undisclosed profiles to create the Undisclosed (minority) variable.

In doing so, profile desirability was found to reduce across all design conditions for profiles reporting a minority ethnicity. In the *Ask Me* condition, desirability of undisclosed non-minority profiles increased, with no significant difference in means found between Undisclosed (non-minority) and Negative, on PrEP profiles ($p > .05$, $\alpha = 0.05$). Significantly, unlike non-minority profiles, minority profiles continued to be affected by reduced desirability even when the undisclosed information field was removed from view, with the means of Undisclosed (minority) ratings being significantly different from the means of Negative ($p < .05$), Negative, on PrEP ($p < .05$) in the *Hidden* condition (see: Figure 4).

6. DISCUSSION
This section discusses our findings in relation to prior research and presents an agenda for future work. We then outline the implications and limitations of this research.

Table 3: Pairwise comparison of estimated means.

Condition	HIV status	Mean diff
Visible	Negative vs. Negative on PrEP	.100
	Neg vs. Pos, Undetectable	1.120**
	Neg vs. Undisclosed	.603**
	Neg on PrEP vs. Pos, Undetectable	1.020**
	Neg on PrEP vs. Undisclosed	.503**
	Undisclosed vs. Pos, Undetectable	.517 **
Hidden	Neg vs. Neg on PrEP	-.063
	Neg vs. Pos, Undetectable	1.127**
	Neg vs. Undisclosed	.174
	Neg on PrEP vs. Pos, Undetectable	1.190**
	Neg on PrEP vs. Undisclosed	.237
	Undisclosed vs. Pos, Undetectable	.953**
Ask Me	Neg vs. Neg on PrEP	.123
	Neg vs. Pos, Undetectable	.939**
	Neg vs. Undisclosed	.402**
	Neg on PrEP vs. Pos, Undetectable	.816**
	Neg on PrEP vs. Undisclosed	.279*
	Undisclosed vs. Pos, Undetectable	.537**

* significant at <.05; ** significant at <.001.

6.1 Is Privacy Unraveling Around These Fields?

The findings from this study suggest that privacy is unraveling around these structured disclosure fields. However, as an indirect measure for testing the construct of *privacy unraveling* was used, it is important to explore an alternative interpretation of this data. Profiles that are not disclosing HIV status information provide less information to participants when making their evaluations. This increase in information asymmetry and uncertainty may explain why the mean rating of Undisclosed profiles is significantly lower than HIV Negative and HIV Negative on PrEP profiles. However, both the *Visible* and *Ask Me* conditions contained the same information as the *Hidden* condition, yet no significant drop in profile rating in the *Hidden* condition was found (see: Fig. 3). This suggests that, whilst the increase in uncertainty may reduce profile ratings, this is not the only reason for this reduction.

In the previous empirical work on *privacy unraveling* within economic contexts (e.g., labour market [9, 35]), most studies found partial unraveling occurring. This means that undisclosed information is perceived as neither the most desirable, nor least desirable, but sits somewhere between these two states [9, 35]. A similar pattern was found in our study in both the *Visible* and *Ask Me* design conditions. In all design conditions, the mean rating of HIV Undisclosed profiles was significantly higher than HIV Positive Undetectable profiles. Therefore, HIV Positive Undetectable users benefit from the non-disclosure option. However, these Undisclosed profiles experienced a significantly lower mean rating than HIV Negative, and HIV Negative on PrEP profiles in the *Visible* and *Ask Me* conditions, whilst no significant difference was found in the *Hidden* condition. As such, users who are HIV Negative, or HIV Negative on PrEP are significantly disadvantaged through non-disclosure in both the *Visible* and *Ask*

Me design conditions, but are not disadvantaged in the *Hidden* condition. Whilst non-disclosure benefits HIV Positive Undetectable users, non-disclosure places them at a disadvantage when compared to users disclosing either an HIV Negative, or HIV Negative on PrEP status. Yet, this study shows that when hiding the Undisclosed HIV status field from view, this disadvantage is reduced to a statistically insignificant level.

6.2 Social Disclosure Norms

Past research suggests that levels of disclosure can be affected by social disclosure norms [62] and through observing other people's disclosure behaviours in online networks [5]. We hypothesised that, if disclosure norms were high, non-disclosure would appear more prominent and lead to higher levels of *privacy unraveling*. Yet, we did not observe this in our data. However, norms typically develop gradually, with people taking time to learn what behaviours are required for a particular group to function [24, 11]. Participants may have been primed through prior interactions with dating apps. Moreover, only the disclosure of the HIV status was changed, which may influence the development of disclosure norms. As such, we are mindful of rejecting this hypothesis, and instead suggest further work which involves the development of sampling methods to recruit participants with different social disclosure norms around dating apps to avoid unnatural priming and to increase future study validity.

6.3 Impact of Other Profile Information

Past research on designing for non-disclosure suggests that removing one piece of information can cause other information to be used to help infer the information that is missing [21]. In online dating environments, Ellison, Heino and Gibbs [23] highlight how the mediated nature of these environments cause fewer *cues* to be available for users to make their evaluations of others. As such, the *cues* that do exist gain an amplified importance. For instance, one of their interview participants reported using the "last activity date" information to infer whether someone had started dating, or had some form of problem in their lives. Another participant used a person's physical body position in their profile picture to infer weight, avoiding users who were sitting down as this acted as a *cue* that they were hiding being overweight.

Doleac and Hansen [21] highlight how this disadvantaged minority groups when applying for jobs when past criminal history information was removed from application forms. Job candidates' ethnicity was then used by prospective employers to infer likely criminal past. In the additional analysis that we performed, the Undisclosed variable was split into two (minority and non-minority). When this variable was split, the *privacy unraveling* around minority profiles increased, whilst the level around non-minority profiles reduced. Where previously the *privacy unraveling* effect was insignificant in the *Hidden* condition, the additional analysis shows minority profiles are still susceptible to *privacy unraveling* even when the undisclosed information field is removed from view. This finding supports prior work [21], which suggests the need to consider and evaluate the unintended consequence of removing information in situations where people are performing evaluation or assessment tasks.

As discussed in the methods section, this study was intentionally designed without profile pictures. Similar to the effect ethnicity has on the mean rating of Undisclosed profiles, profile pictures may also be used to infer undisclosed information. For example, profile pictures provide visual cues to a person's ethnicity and age. If this information is not disclosed, it may be inferred through these cues. Moreover, prior work suggests men are significantly influenced by profile pictures on dating profiles [48, 8], which could influence the impact *privacy unraveling* has on undisclosed information. Other information (e.g., demographics, profile pictures) may influence the effect of *privacy unraveling*. Future research could explore how such information affects the way people evaluate undisclosed information, and could provide better understanding of how this may disadvantage certain minority groups.

6.4 Privacy Unraveling as an Indirect Disclosure

Prior work suggest that the effect of *privacy unraveling* may facilitate a form of indirect disclosure, which would allow users living with HIV to indirectly disclose by purposefully concealing their status [66]. The findings from this study suggest that this is an ineffective indirect disclosure strategy. However, as prior research has shown, indirect disclosures often rely on a sub-group being able to interpret the hidden message within a message [43, 6]. The majority of our participants reported being HIV Negative (89.8%), with only 4.3% reporting to be living with HIV. If users living with HIV interpret non-disclosures as people also living with HIV, the small size of this population within our sample would not show this effect. Therefore, future research could explore how sub-groups interpret non-disclosures to understand how the *privacy unraveling* effect may facilitate indirect disclosure within these groups. For instance, whether people living with HIV are more likely to infer an HIV Positive status from non-disclosure, making non-disclosure a viable form of indirect disclosure.

6.5 Ambiguity Around Non-Disclosures

Structured fields can limit a user's ability to disclose their status within a rich narrative [65]. Narratives that develop around these fields can be derived from both the sender and receiver. The receiver may develop their own narrative around disclosed information, as well as any act of non-disclosure. Additional information provides a more constrained environment around which interpretations can develop [12]. Other information (e.g., ethnicity), or profile completeness [66], may be used to shape a "something to hide" interpretative narrative around non-disclosures. Our study provides some support for prior work [33] which suggests that ambiguous labels (i.e., "Ask Me") have a negative impact on the way profiles are evaluated by users. However, in our study no significant difference was found between the *Ask Me* and *Visible* design conditions. This suggests that the "Ask Me" design used in some MSM oriented online dating websites provides no more ambiguity than that of the more traditional "Prefer not to say" design.

However, our analysis shows that the negative impact of this 'Ask Me' label may be more significant for minority users. Ambiguity in interactions is relied upon for indirect forms of disclosure of sensitive information, both offline [19] and

online interactions [5, 6, 31, 43]. Whilst prior work [66] suggests non-disclosure around structured disclosure fields may provide the ambiguity needed to support indirect disclosure, as discussed above, further work is needed to understand the conditions under which this may occur. Further work could explore how structured fields could be designed to increase ambiguity, especially around non-disclosures. E.g., exploring the implementation of both an explicit non-disclosure option (e.g., a user manually sets "Ask Me", and a implicit non-disclosure option (e.g., the default option is 'prefer not to say').

6.6 Implications

This study highlights the complexity and fragility around structured disclosure fields. Whilst on the surface they appear simple, when people start to interact with them, their complexities emerge. We highlight how the current non-disclosure options in structured fields may not be effective in providing users with disclosure choice, as non-disclosure may disadvantage users. Reducing the visibility of fields may help to increase the effectiveness of the non-disclosure options, but may not be effective for all users. Designers should consider how other profile information may be evaluated differently in the absence of other sensitive information. We do not provide any explicit implications for design in this paper as it is clear from this study that further work is needed to better understand this complex area of social research. However, throughout this discussion we have provided an agenda for future work.

6.7 Limitations

This study was conducted with a skewed sample of predominately younger, white, European participants. Structured disclosure fields are fragile to social change, therefore our findings may differ across cultures. Within the context of HIV, behaviours are likely to differ depending on levels of stigma. This study used the context of HIV status in sex-social apps to explore privacy unraveling. HIV status in this context can be highly sensitive information. Further work is needed to understand how our findings generalise to other sensitive information types.

7. CONCLUSIONS

Whilst prior research found structured disclosure fields restricting forms of individual expression for marginalised groups [31], our findings suggest that these same disclosure fields can limit disclosure choice, and similarly disadvantage marginalised users. Whilst this work shows how design can be used to reduce the effect of *privacy unraveling* leading to an increase in disclosure control, this may not be effective for marginalised groups. This study shines a spotlight on a simple, yet commonly used form field, and raises further questions that need to be explored within this area of social research. This is needed to ensure disclosure control is appropriately implemented into these fields and to better understand how indirect disclosure may occur through their use.

8. ACKNOWLEDGEMENTS

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