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Measuring the Effects of Gender on Online Social Conformity

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Social conformity occurs when an individual changes their behaviour in line with the majority's expectations. Although social conformity has been investigated in small group settings, the effect of gender – of both the individual and the majority/minority – is not well understood in online settings. Here we systematically investigate the impact of groups' gender composition on social conformity in online settings. We use an online quiz in which participants submit their answers and confidence scores, both prior to and following the presentation of peer answers that are dynamically fabricated. Our results show an overall conformity rate of 39%, and a significant effect of gender that manifests in a number of ways: gender composition of the majority, the perceived nature of the question, participant gender, visual cues of the system, and final answer correctness. We conclude with a discussion on the implications of our findings in designing online group settings, accounting for the effects of gender on conformity.

CCS Concepts: • **Human-centered computing → Empirical studies in collaborative and social computing**; *Empirical studies in HCI*.

Additional Key Words and Phrases: Social Conformity; Gender; Gender-typed Questions; Names; Avatars; Online Quiz; Majority Size; Self-reported Confidence

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1 INTRODUCTION

Conformity is a widely studied form of social influence that leads individuals to change their personal judgements and opinions when challenged by an opposing majority [2]. Deutsch and Gerard [20] explain that such behaviour is commonly motivated when individuals attempt to fit in with a group (*i.e.*, normative influence), or are seeking guidance in uncertain situations in an attempt to be right (*i.e.*, informational influence). As our social interactions increasingly shift towards online platforms, with over 4 billion Internet users and over 74% of those active on social media [35], investigating whether and how social conformity manifests and influences human behaviour in online group settings is important in order to facilitate positive interactions.

The literature on face-to-face social conformity suggests that individuals are influenced by a number of different determinants when conforming to the majority's opinion, such as majority size [3, 46] and their self-confidence [13, 65]. Furthermore, research on the effects of gender on social influence in face-to-face groups has shown that women are typically more receptive to others' opinions while men are seen to be more influential in certain cases [22], meaning that women are generally seen to conform more than men under group pressure [24, 25]. However, due to the inherent

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dissimilarities between physical and online groups [52], it is unclear if observations resulting from the above seminal studies apply to online settings.

More recent literature investigating the implications of gender in computer-mediated communication (CMC) settings reveal effects of partner gender on 'informational' social influence [41, 42]. These studies show that individuals are more likely to accept the opinions of a stereotypically male-charactered partner in stereotypical masculine topics and those of a stereotypically female-charactered partner in stereotypical feminine topics. Moreover, work by Christofides et al. [15] identifies the presence of gender identification in online discussions, where men perceived interviewers with stereotypical masculine names to be more competent than interviewers with stereotypical feminine names, regardless of the topic of discussion. One shortcoming of these studies is that they are limited to exploring gender effects in pairs, and do not consider larger groups.

Furthermore, despite early expectations that reduced social presence in online settings would facilitate more unbiased modes of communication for all those involved [21, 37], recent literature invalidates this notion. For example, in contexts where gender is not directly specified, individuals perceive the gender of their online correspondents through their names [15, 45], usernames [19], avatars [41, 42], and even linguistic use [32, 61], triggering stereotypical behaviour. However, the effects of these different gender cues on social conformity have not been measured in online settings.

This study aims to explore the impact of three gender-based aspects on conformity, while also validating findings from previous work on the impact of majority size and self-confidence. First, we investigate how different gender group compositions in the majority and the minority may affect online conformity behaviour of participants. Since the experiment is related to an online setting, we utilise commonly used stereotypical gendered representations (*i.e.*, masculine and feminine avatars and names) to illustrate different gender compositions. Second, we compare these two stereotypical gendered representations (avatars and names) in terms of triggering gender-related stereotypes and gender-biased conformity. Finally, we also investigate whether the self-disclosed gender identity of participants affects their susceptibility to such gender-biased stereotypes leading to social conformity.

We deploy an online quiz containing multiple-choice questions on topics that are stereotypically seen as being of masculine (sports) and feminine (fashion) nature, as well as neutral questions. Participants first answer each question privately while providing their self-reported confidence on the selected answer. Next, our software displays a fabricated distribution of peer answers denoting a clear majority, while placing the participant in either the minority or majority. To assess the impact of gender cues on triggering stereotypical perceptions among participants, we introduce a total of three conditions: a control condition in which participants were not aware of the gender of their peers; a condition with stereotypical masculine and feminine names; and finally a condition with stereotypical masculine and feminine avatars. Subsequent to displaying the fabricated peer answers, participants are given the opportunity to change both their initial answer and self-reported confidence. We consider a change to the participant's answer to be a sign of conformity when the change is in line with the majority's opinion.

While our results did not indicate a main effect of self-disclosed gender of participants on conformity, we observe stereotypes on supposed competency based on perceived peer gender. In instances where peers are represented by gender-rich names or avatars, our results show an increase in conformity when it comes to stereotypical masculine and feminine questions. Both men and women are more likely to accept the majority's answer to a stereotypical masculine question when the majority consists of more stereotypical masculine avatars or names as compared to a majority which consists of more stereotypical feminine avatars or names. We observe a similar behaviour for stereotypical feminine questions, when the majority had more stereotypical feminine avatars or names than stereotypical masculine avatars or names. Such conformity behaviour was more frequent when peers are represented using avatars as opposed to names. Our analysis also considered the consequences of conforming to the majority in terms of final answer correctness: participants were more likely to conform to an incorrect answer, especially in stereotypical masculine and feminine questions. We conclude with a

discussion on the implications of our findings in designing for online groups so that individuals are less influenced by stereotypical gender biases, especially with regard to 'informational' social influences.

2 RELATED WORK

Asch's conformity experiments [2, 3] are a landmark in Social Psychology research, where a significant proportion of participants (33.3%) revised their individual judgements to agree with a clearly incorrect, yet unanimous majority, establishing the existence of conformity in group settings. A subsequent study revealed two motives behind group conformity: normative and informational influences [20]. The researchers described 'normative influence' as the tendency to conform to expectations of the majority to be 'liked' within the group, while accepting the majority's judgement to be more accurate than one's own knowledge of the situation was described as 'informational influence'. More recent work explained conformity as an outcome of individuals being driven to ensure one's belongingness to a group [17] or to fit in with the majority [44], further establishing the impact of 'normative influence' on conformity. Moreover, previous work has further emphasised the effects of 'informational influence' on conformity, where individuals turn to groups for direction in situations where the 'correct' response is unclear [16, 44].

As social interactions are increasingly shifting from physical paradigms to online settings, investigating whether and how social conformity manifests in online groups is vital. Next, we summarise the research that has been conducted in this area.

2.1 Online Social Conformity

Due to the increased use of online platforms (*e.g.*, discussion forums, support groups, learning platforms), human interactions are increasingly taking place online [28, 58]. Therefore, the extent to which physical social influences manifest in an online setting has been of interest to the research community.

Previous work has argued that online groups are affected by social influences similar to face-to-face groups [52], despite reduced effects in the former. This notion is further supported by literature comparing social conformity in online and offline settings. For example, work by Cinnirella and Green [18] extended Asch's 'line experiment task' by allowing participants to select their answers through computer-mediated communication (a personal computer), offering participants anonymity. The results of this experiment were compared against a traditional face-to-face group setting, and showed that conformity was still apparent in the anonymous computer-mediated group, despite demonstrating lower effects when compared to the face-to-face group. On the contrary, work by Reicher et al. [57] argues that anonymity of computer-mediated groups could lead to 'deindividuation', where individuals tend to lose self-awareness as a result of extreme involvement with the group. This in turn can encourage individuals to more strongly conform to group norms [55, 56]. More recent literature investigated conformity during social watching, where people discuss social issues with others through online social networks while simultaneously watching video telecasts. The researchers observed that people tend to adopt the majority's opinion on social issues, even when they do not know the users who are posting the content [48]. Another study by Maruyama et al. [49] showed that users who actively tweet during a televised political debate changed their voting choice to reflect the majority sentiment on Twitter, further showcasing the presence of social conformity in online settings.

Furthermore, literature suggests that social conformity exhibits both positive and negative implications in online settings. Sukumaran et al. [64] explored the use of normative conformance in shaping the amount of effort users put into their contributions in online news websites. The study highlighted that when the initial comments added by other users were more 'thoughtful', subsequent participants were also motivated to contribute with similar or additional effort. The researchers concluded that conformity can be used to establish a long-term positive structure within online communities, when applicable. However, a more recent study investigating social conformity in virtual classrooms portrayed its negative influences [9]. This study required graduate students to answer an online quiz where a proportion of participants were shown the responses of others in the

group, while the remaining participants answered the quiz independently. The resulting observations revealed high levels of conformity among students in online learning environments, rationalised by their lack of understanding of the content as well as high levels of self-doubt. More importantly, students who conformed to the majority's answers obtained fewer correct answers compared to students who answered the quiz independently.

Recently, a study based on an online support group described how mental health patients conforming to the linguistic norms of the community received better support as compared to those who did not [62]. This study set forth both positive and negative implications of conformity. On one hand, the researchers observed that conforming to the acceptable conventions of behaviour improved the sense of belonging and security within the community, so that sensitive mental health issues could be openly discussed. However, they also argued that pressure to conform to the group's norms may cause unnecessary distress to individuals seeking support from online communities.

As the literature shows that social conformity can have mixed effects in online social groups, we argue that in order to derive positive outcomes through this powerful social influence a more thorough understanding of its determinants is needed.

2.2 Determinants of Social Conformity

2.2.1 Majority Size and Self-confidence. Since conformity is a social influence exerted by a group's majority on the group's minority or minorities, the size of the influencing source (majority) is an obvious determinant, and has been thoroughly researched in face-to-face groups. For instance, Asch explored how conformity was affected by subsequently increasing the size of a unanimous majority [3]. He observed that against a minority of one, the influential power of the majority increased until its third member, while adding a fourth member to the majority did not generate a higher conformity influence. A subsequent study explained that larger majorities exert more pressure on individuals to conform as a result of higher normative and informational influences [33]. Moreover, a study by Lowry et al. [46] compared the conformity effects of two group sizes (3 and 6), when the communication was face-to-face and computer-mediated. Their results show that while conformity effects heightened in both conditions as the group size increased, the effect was minimised in the computer-mediated condition. Thus, it is plausible that online groups may not be affected by adverse influences of social conformity, even with increasing group sizes. However, this notion is yet to be systematically tested in online settings.

Previous work has shown that conformity is driven by informational influences, where individuals confide in judgements of a group's majority as the accurate interpretation of a given situation, disregarding their own judgements [20]. This notion implies that confidence in one's judgements may play a role in determining the likelihood of a person conforming. This relationship has been established in face-to-face groups, where higher rates of conformity were observed when individuals displayed low confidence on their personal answers and higher confidence on group's answers [13, 60, 65]. Furthermore, Rosander and Eriksson [59] observed that individuals in online groups who considered the experimental tasks to be difficult more frequently conformed to incorrect majorities than those who did not. However, the impact of self-confidence on conformity is yet to be explored in-depth with regard to online groups.

In this paper we validate findings from previous work on the influence of majority size and self-confidence on conformity in online settings, while also exploring the impact of gender and gender cues.

2.2.2 Gender and Gender Cues. The effects of gender on social conformity has been a topic of interest in Social Psychology research. Early literature concerning face-to-face groups revealed that women are more easily swayed by external influence than men [22], leading to higher conformity under group pressure settings [23]. Moreover, Eagly and Wood [24] explained gender differences in conformity as a result of stereotypical gender-oriented social roles that individuals are expected to follow in groups. For example, while men are expected to be more 'agentic' and task-oriented,

women are expected to be cooperative and selfless, when placed in group settings. This notion is further emphasised in [67], where men were wrongly perceived to be more competent than women in group discussions, leading them to actively contribute opinions, while women were more likely to agree with the group's opinions demonstrating cooperative social behaviour.

Despite the optimistic expectations for computer-mediated communication (CMC) to enable unbiased communication [21, 37], literature emphasises that this is not always the case. While men and women do not differ in their basic online skills, previous work has shown that women tend to self-assess their skills as being less advanced when compared to the self-assessment of men, which can affect their confidence and online behavior [31]. In addition, Matheson [50] observed that individuals form stereotypical perceptions of their online correspondents based on gender, where women were perceived to be more cooperative and less exploitative than men. Moreover, work by Postmes and Spears [54] highlighted that 'deindividuation' caused by computer-mediated communication tend to enhance stereotypical perceptions and behaviour among individuals.

More recent work further establishes the notion that men and women respond to the gender of their peers differently, especially when connected with stereotypical masculine and feminine tasks. For example, in a study by Christofides et al. [15] where participants rated the effectiveness of their interviewers subsequent to an online discussion, women rated interviewers with stereotypical feminine names as more competent in stereotypical feminine topics with similar results for interviewers with stereotypical masculine names in stereotypical masculine topics. However, men rated interviewers with stereotypical masculine names as more competent regardless of the topic of discussion. Another study by Lee [41] demonstrates similar behaviour where women conformed to stereotypically female-charactered partners in stereotypical feminine topics and stereotypically male-charactered partners in stereotypical masculine topics, while men displayed greater conformity to stereotypically male-charactered partners even in stereotypical feminine topics. While existing literature adequately highlights the prevalence of gender stereotyping in online settings, they limit their analysis to pairs of individuals. Thus, in this paper we explore the implications of gender stereotypes on social conformity with regard to small online groups.

Moreover, existing literature reveal that users of CMC platforms infer gender of their peers through cues such as names [15, 45, 51], usernames [19] and avatars [41, 42]. These cues play a significant role in triggering gender stereotypes in online settings when gender is not explicitly provided. For example, a study by Lee [42] demonstrates that participants inferred the gender of their anonymous partners based on a randomly assigned gender-marked character (which may or may not correctly represent partner gender), where stereotypical masculine characters triggered higher conformity than stereotypical feminine characters. Moreover, while previous work has shown that certain cues may be more powerful in triggering stereotypical perceptions of others [43], their effects on conformity is yet to be explored.

3 METHOD

We aim to investigate the impact of group gender composition on online social conformity across different question types and gender cues. To control these aforementioned variables, while simultaneously simulating a plausible real-world online setting, we deployed our study as an online multiple-choice question (MCQ) quiz. Previous work has successfully utilised MCQ quizzes to capture occurrences of online social conformity [9, 39, 59].

3.1 The Quiz

The quiz contained 39 objective MCQ questions equally distributed among topics which are stereotypically perceived to be masculine (sports), feminine (fashion), and neutral (general knowledge). We include the complete list of questions used in the quiz as supplementary material. The choice of stereotypical masculine and feminine topics was based on existing literature studying gender-stereotyping in computer-mediated communication [40–42]. The results from these studies established that the

chosen question topics (fashion and sports) successfully trigger gender stereotypes. We chose general knowledge based topics to represent neutral questions. This is in line with recent literature on conformity that deployed similar MCQ quizzes and showed no gender differences in conformity for these questions [39, 59].

Once the topics were decided as fashion (feminine), sports (masculine), and general knowledge (neutral), we extracted potential multiple-choice questions covering these topics from popular online question repositories such as Britannica and Sporcle for sports, BuzzFeed for fashion, and Syvum for other general knowledge questions. Next, we employed a similar approach used in previous work on social conformity to rate the perceived masculinity and femininity of questions [40–42]. Two of the paper's authors individually rated the perceived masculinity and femininity of the questions on ten-point Likert scales (1 – Not at all masculine/feminine to 10 – Extremely masculine/feminine). Perceived masculinity ratings were reverse-scored and added to the perceived femininity rating to arrive at a final score for each question. For neutral questions, the same authors rated how gender-biased the questions were in a ten-point Likert scale, regardless of the perceived masculinity or femininity of the question (1 – Not at all gender-biased to 10 – Extremely gender-biased). We then aggregated the scores given to each question and selected the top 13 questions from each topic (*i.e.*, sports, fashion, and general knowledge) to be included in the quiz to represent stereotypical masculine and feminine questions, as well as neutral questions. The purpose of having different types of questions was to determine whether gender bias relative to conformity is heightened due to question stereotypes. We only selected objective questions from the aforementioned topics as we intend to determine the impact of conformity on final answer correctness.

The quiz follows the structure illustrated in Fig. 1. First, the user is instructed to attempt the question by themselves and select the correct answer option (see Step 1 in Fig. 1). Upon choosing an answer option, the user is prompted to rate their confidence in the chosen answer. Self-reported confidence levels were denoted using a scale ranging from 0 – 100 with higher values representing higher levels of confidence. Subsequently, the user is presented with a fabricated diagram claiming to show how their peers have answered the same question (see Step 2 in Fig. 1). The fabricated peer answers were dynamically generated by our software to show the distribution of votes from other participants across two answer options in such a way that one answer secured a clear majority of votes. This notion of using fabricated feedback diagrams to investigate social conformity was inspired by work from Rosander and Eriksson [59]. Following the display of the peer answers, the user is then given the option to maintain their original answer or change the originally selected answer option and confidence (see Step 3 in Fig. 1).

3.2 Gender Cues

We introduce three conditions to analyse the impact of different gender cues in triggering stereotypes influencing social conformity. The conditions differ only by the peer answer diagrams presented to the participants, as shown in Step 2 of Fig. 1. We deployed a control condition (see Fig. 1 Step 2 (a)) where a vote was represented by a grey square, removing any gender cues from peer answers. In contrast, the second condition (referred to as the 'names' condition) displayed names of peers (see Fig. 1 Step 2 (b)), and the final condition (referred to as the 'avatars' condition) represented peers through two stereotypically gendered masculine and feminine silhouette avatars (see Fig. 1 Step 2 (c)).

We highlight that the choice of gendered representations (names and avatars) used in the study was based on the fact that these representations are commonly seen in many online social platforms such as Facebook, Goodreads, and Learning Management Systems such as SAP Litmos, where user decisions can be influenced by others. We do not consider a gender-neutral avatar as it is less likely to trigger gender-based stereotypes. We highlight that the study already includes a control condition (with no gender cues), against which we compare the conditions with gender cues (both names and avatars).

Furthermore, we ensured that the representation of a peer answer had an identical length in all conditions to ensure visual consistency in the presentation and avoid any additional bias.

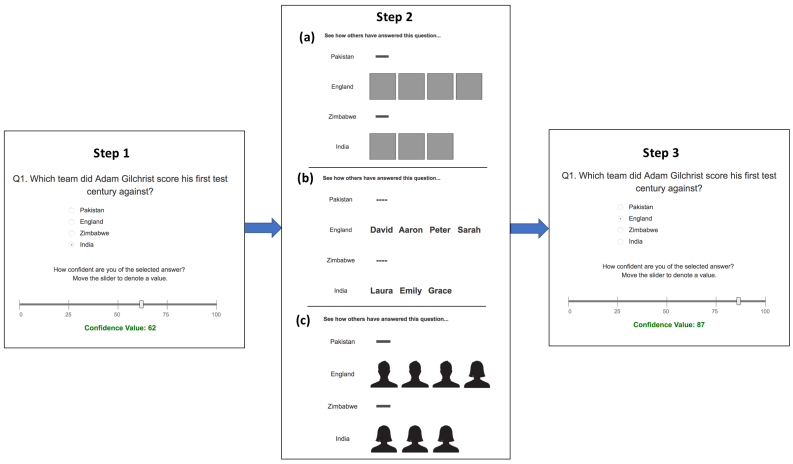

Fig. 1. Steps to be followed during the quiz : Step 1: Initial answer and confidence, Step 2: View peer answers (participants will see the representation pertaining to each condition), Step 3: Final answer and confidence.

3.2.1 Names. Our 'names' condition is based on the literature that explains how names of individuals can be used to infer gender in online settings [15, 45]. We extracted the top most frequently used stereotypical masculine and stereotypical feminine names in the chosen community, so that participants are more likely to be familiar with the displayed peer names. We selected names that clearly suggested the gender of the peer (such as 'David' and 'Sarah') and avoided using names (such as 'Sam') which can be perceived as more ambiguous.

3.2.2 Avatars. Similarly, literature supports the notion that avatars (a frequently used method of online self-representation) are strong cues in triggering gender perception in online settings – in turn eliciting gender stereotypical behaviour [40, 53]. To minimise the effect of other possible traits that could be inferred from avatars such as participant race [4, 29], ethnicity [66], personality [26] and age [68], we utilised two frequently used silhouette avatars with minimum user cues to represent men and women in the majority and the minority (as displayed in Fig. 1 (c)).

3.3 Group Composition

We chose to work with an overall group size of seven in all three conditions (*i.e.*, the size of the majority plus the size of the minority – excluding the participant attempting the quiz – sums up to seven). Previous work that focused on the effects of group gender composition on influence and group work use either same or mixed-gender dyads [14] or groups of 4 participants [34], which restricted the possible gender group compositions that could be tested. In contrast, a group size of seven allowed us to test the following gender group compositions in a majority as well as a minority, with different gender group sizes.

- `F > M`: The group consists of more stereotypical feminine names or avatars than stereotypical masculine names or avatars.
- `M > F`: The group consists of more stereotypical masculine names or avatars than stereotypical feminine names or avatars.
- `M = F`: The group consists of an equal number of stereotypical masculine and feminine names or avatars.
- `F`: The group consists of only stereotypical feminine names or avatars.
- `M`: The group consists of only stereotypical masculine names or avatars.

We did not choose a group size higher than 7 as this would require us to include more questions in the quiz (already at 39 questions) – further increasing participant strain. Each question in the quiz displayed a fabricated peer answer diagram that reflected a specific group gender composition (out of F > M, M > F, M = F, M and F) for the majority and the minority, while maintaining a total group size of 7. The majority group size ranged from 4 to 6 peers while the corresponding minority ranged from 3 to 1 peers. For example, a possible group composition could be a majority of 5 with 3 stereotypical feminine avatars/names and 2 stereotypical masculine avatars/names (F > M), alongside a minority of 2 with 1 stereotypical masculine avatar/name and 1 stereotypical feminine avatar/name (M = F).

Once a participant submits their initial answer and confidence, our software dynamically produced a fabricated peer answers diagram which displayed a manipulated distribution of votes across two answer options, placing the participant either in a majority (9 out of 39 questions) or a minority (30 out of 39 questions). For instance, the Fig. 1 (c) illustrates a question where the participant was placed in an minority consisting of 3 stereotypical feminine avatars (F), against a majority consisting of 3 stereotypical masculine avatars and one stereotypical feminine avatar (M > F).

We counterbalanced the question types (*i.e.*, neutral, masculine, feminine) and group gender compositions in such a way that, for a given group gender composition, an equal number of participants answered questions pertaining to each question type.

3.4 Participants and Procedure

We recruited 54 participants [1] from different educational backgrounds which included engineering, science, arts and design, commerce and marketing fields. The group consisted of 27 women and 27 men. We do not know whether the participants were trans or cisgender as participants did not disclose this information. Participants' age ranged between 18 – 34 years. All participants were recruited through an online notice board. Participants were equally distributed among the 'control', 'names', and 'avatars' conditions, with 9 men and 9 women in each group. Within each condition, an equal number of men and women were assigned to question sets 1, 2, or 3 to counterbalance both questions types and group gender compositions.

The experiment was conducted in a laboratory with one participant per session and under the supervision of a researcher. Participants were informed that the objective of the study was to determine the importance of peer feedback in online settings, as the true purpose of the study could not be disclosed prior to the quiz as expected in studies investigating conformity behaviour [63].

Participants then completed an online form which collected their gender, age, and educational background. We highlight that participants were given the opportunity to self-disclose their gender without being restricted to binary gender identities (or not disclose at all) [36]. Upon submitting their demographic details, participants were randomly assigned to either the control, 'names', or 'avatars' condition. In the home screen of our application, the participants were greeted by a conversational agent named 'QuizBot', which assisted participants in familiarising themselves with the environment through a training question as displayed in Fig. 2.

Training was considered essential to ensure that the participants were aware of the process to be followed during the quiz. We utilised the 'QuizBot' to provide step-by-step instructions to participants during the training while minimising the intervention of researchers. This enabled us to simulate a typical online setting where participants were by themselves while minimising any gender biases that could occur due to the presence or intervention of the researchers. After training, the bot directed participants to the quiz. All participants completed the quiz individually, repeating the steps described in Fig. 1.

[1] Due to a database error, we had to discard responses generated by 18 participants - and subsequently recruit 18 additional participants to compensate for this error. Therefore, while we recruited 72 participants in total, the findings of this study originate from 54 participants.

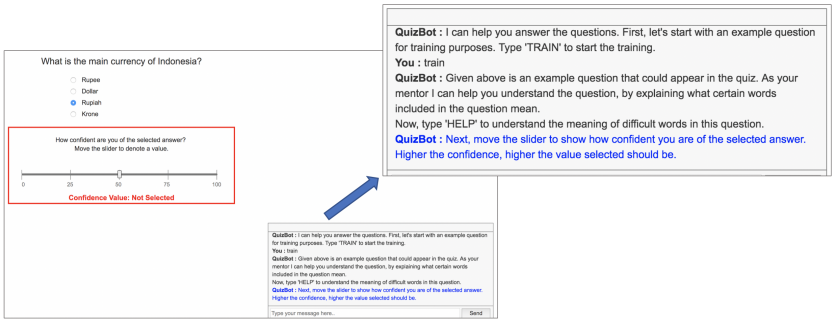

Fig. 2. QuizBot assisting the participants through step-by-step instructions during training.

Upon completion of the quiz, participants participated in a brief semi-structured interview in which they were debriefed on the true objective of the study. Subsequently, we enquired what were the main reasons behind their decisions to change their initial answer during this quiz. We were also interested in whether they sought out the answers from peers of a particular gender with regard to certain types of questions, to understand whether and why participants actively inferred gender of others through the feedback they received when deciding the final answer. Participants were also asked to comment on the strength of the gender cues (in 'names' and 'avatars' conditions), to determine the effect of these gender cues in suggesting stereotypical behaviour in online settings.

The experimental design was approved by the Ethics Committee of our university. The experiment lasted for approximately 60 minutes per participant, including briefing, training, completing the quiz, and final interview. Each participant received a $15 gift voucher for participation.

4 PILOT

Before running our experiment, we conducted a pilot study with 20 participants (10 men and 10 women). In this pilot, study participants individually answered the same set of stereotypically perceived masculine, feminine, and neutral questions under lab conditions (they were not shown other people's answers). This resulted in a total of 780 responses. We observed that for all questions, participant answers dispersed among mostly two answer options. Moreover, for 20 (out of 39) questions, the majority of participants selected the correct answer. The overall group accuracy was approximately 38% (299 out of 780 responses). Overall, we identified that participants were most correct in answering neutral questions (45% correct responses) and least correct on the questions that are stereotypically perceived as being of masculine nature (28% correct responses). However, we did not observe any statistically significant relationships between gender and different question types, meaning that popularly perceived stereotypical relationships between participant gender and the perceived nature of questions were not reflected in our answer set.

Next, we arranged the answer options of each question based on the descending order of the number of votes they received during the pilot study. This data was then used to determine the arrangement for the majority and minority groups when fabricating peer answers. For instance, for the question illustrated in Fig. 1, "India" and "England" were the top two answer options chosen by the pilot participants. Thus, when a study participant attempting the quiz selected "India" as their initial answer, our software dynamically fabricated the illustrated diagrams placing "England" as the majority answer. This ensured that the majority was always placed in a reasonable answer option, regardless of being correct or incorrect.

5 RESULTS

We asked 40 questions from each of the 54 participants (1 training question and 39 quiz questions). Responses to training questions were removed from the dataset prior to analysis, which resulted in 2106 answered questions. Our software placed participants both in the majority (for 9 out of 39 questions) as well as in the minority (for 30 out of 39 questions) to cause no suspicion about the authenticity of the peer answers. Thus, the participants were in the majority in 486 questions and in a minority for the remaining 1620 questions (equally distributed among topics which are stereotypically perceived to be masculine, feminine, and neutral). We note that our intention was not to compare results between majority and minority groups, but rather to explore the impact of different group gender compositions on conformity behaviour among individuals. Upon seeing the answers of their peers, participants could either:

- Change both answer option and confidence level.
- Change only their answer option.
- Change only their confidence level.
- Make no change to their initial answer.

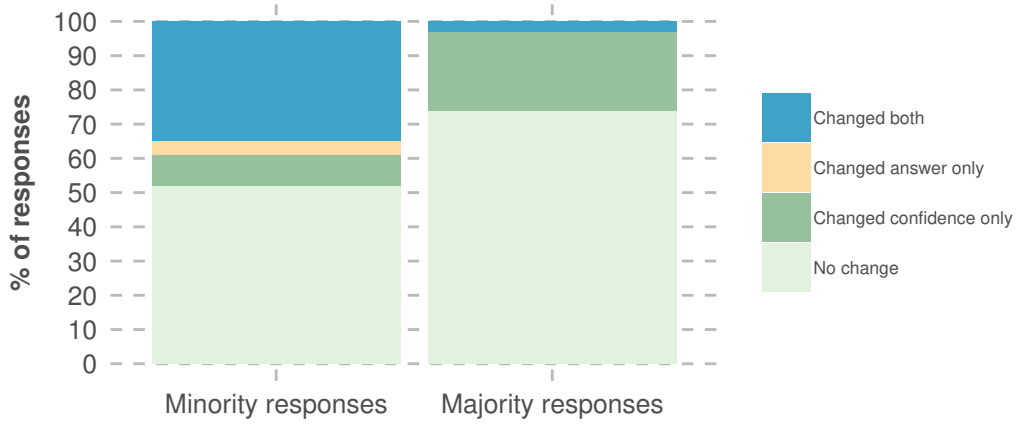

Fig. 3. Distribution of changed responses across the four post-feedback response types.

Our results show that all participants changed their initial response (answer option and/or confidence) at least once during the quiz, resulting in a total of 904 changes with an average of 16.74 changes (SD = 7.33) per participant. Out of these 904 changes, 777 were made by participants placed in the minority and the remaining 127 from participants placed in the majority. The distribution of the final responses of participants across the aforementioned response types is shown in Fig. 3.

As illustrated by Fig. 3, the act of conformity (changing one's answer) occurred predominantly when participants were placed in the minority (approximately 39% of the minority responses). Moreover, participants were more likely to increase their confidence (approximately 23%) than changing their answer when placed in the majority. Only 3% of the responses generated by participants placed in majorities demonstrated a change in their answers to that of the minority.

5.1 Model Construction

The objective of this study was to determine the impact of participant gender and group gender composition across different question types on online social conformity. Thus, we considered the impact of the following 15 predictor variables on whether an individual will conform to the majority's answer.

M = num. of stereotypical masculine names or avatars, & **F** = num. of stereotypical feminine names or avatars.

- **Majority size**: Size of the majority (ranging from 4 - 6).
- **Minority size**: Size of the minority (ranging from 3 - 1).
- **Group difference**: Difference between the majority group size and the minority group size (possible values : 1, 3 or 5).
- **M in the majority**: Number of stereotypical masculine names or avatars in the majority group (ranging from 0 - 6).
- **F in the majority**: Number of stereotypical feminine names or avatars in the majority group (ranging from 0 - 6).
- **M in the minority**: Number of stereotypical masculine names or avatars in the minority group (ranging from 0 - 3).
- **F in the minority**: Number of stereotypical feminine names or avatars in the minority group (ranging from 0 - 3).
- Δ **(M - F) in the majority**: The difference between the number of stereotypical masculine names or avatars in the majority and the number of stereotypical feminine names or avatars in the majority (ranging from -6 to +6, positive values when there are more masculine names or avatars).
- Δ **(M - F) in the minority**: The difference between the number of stereotypical masculine names or avatars in the minority and the number of stereotypical feminine names or avatars in the minority (ranging from -3 to +3, positive values when there are more masculine names or avatars).
- Δ **(M in the majority - M in the minority)**: The difference between the number of stereotypical masculine names or avatars in the majority and the number of stereotypical masculine names or avatars in the minority (ranging from -3 to +6, positive values when there are more masculine avatars or names in the majority than in the minority).
- Δ **(F in the majority - F in the minority)**: The difference between the number of stereotypical feminine names or avatars in the majority and the number of stereotypical feminine names or avatars in the minority (ranging from -3 to +6, positive values when there were more feminine avatars or names in the majority than in the minority).
- **Question type**: Masculine, feminine, or neutral question type.
- **Initial confidence**: Participant's confidence in their answer prior to revealing the distribution of peer answers (ranging from 0 to 100, higher values for higher confidence).
- **Gender**: Participant's self-disclosed gender.
- **User ID**: An unique identifier assigned to a given user during the quiz.

We used the R package *lme4* [8] to perform a generalised linear mixed-effects model (GLMM) analysis of the relationship between the aforementioned predictors and participant conformity. A GLMM allows us to identify the effect of a set of predictors on an outcome variable (conformity) while following an arbitrary (*i.e.*, possibly non-normal) distribution.

We utilised three separate models to analyse data under the three experimental conditions 'names', 'avatars', and control condition. As the control condition did not display gender cues, the corresponding model did not consider gender-oriented predictors. Moreover, we considered a change in the initial answer option (with or without a change in initial confidence level) to that of the majority, as an indication of conformity behaviour. We observed that in some situations participants also reduced their confidence on the selected answer without conforming to the majority's answer option. However, we did not consider a reduction in confidence when challenged by a majority as conformity behaviour. We specified participant (User ID) as a random effect to account for individual differences in our model.

Following model selection (incremental addition of variables based on their predictive power), we arrived at three models for each condition, demonstrating statistically significant main effects and interactions as illustrated in Table 1. The R^2 values given in Table 1 represents the percentage of the variance in accuracy explained by each model. Moreover, for each model we performed a likelihood

Predictor	Control		Names		Avatars	
	Coef.	P-value	Coef.	P-value	Coef.	P-value
Group difference	**0.949**	**< 2e-16**	**0.727**	**< 2e-16**	**0.711**	**< 2e-16**
Initial confidence	**-0.021**	**9.57e-05**	**-0.023**	**6.09e-08**	**-0.023**	**5.28e-08**
Question type (fem)	**-0.888**	**0.036**	0.544	0.051	-	-
Question type (mas)	0.591	0.145	**0.685**	**0.015**	-	-
Question type (mas) : Gender (m)	**-1.964**	**0.022**	-	-	-	-
Question type (fem) : Gender (m)	-0.569	0.509	-	-	-	-
Question type (neu) : Gender (m)	-0.939	0.271	-	-	-	-
Question type (mas) : Gender (m) : Δ M-F in maj.	-	-	0.088	0.245	**0.244**	**0.003**
Question type (fem) : Gender (m) : Δ M-F in maj.	-	-	**-0.166**	**0.037**	**-0.151**	**0.056**
Question type (mas) : Gender (w) : Δ M-F in maj.	-	-	**0.209**	**0.008**	**0.416**	**4.48e-06**
Question type (fem) : Gender (w) : Δ M-F in maj.	-	-	-0.058	0.443	**-0.223**	**0.006**
R^2	0.349		0.392		0.371	
Chi^2	209.71 (p < 0.001)		196.95 (p < 0.001)		201.76 (p < 0.001)	

Table 1. Effect of predictors on participant conformity across the three models.

ratio test with the relevant null model [10] and found that all three models were statistically significant (see Chi^2 values in Table 1). To ensure the validity of the model, we checked for the existence of multicollinearity. All predictors across the three models had variance inflation factors well below the often-used threshold of 5 to detect multicollinearity [30].

Following model construction, we present a more detailed look at the significant features. We only considered the responses which placed participants in a minority, as the dependent variable was determining conformity behaviour.

5.2 Group Size and Initial Confidence

Our results show that in all three models group difference (difference between the majority size and the minority size) and initial self-reported confidence of participants demonstrated statistically significant main effects on conformity behaviour. This suggests that as the size difference between the majority and the minority groups increased, participants in all three conditions were more likely to conform. The likelihood of participants conforming to the majority in all three conditions is illustrated by Fig. 4. For each participant, the 'likelihood' of conforming for a given group difference was calculated as the proportion of conformity responses out of total responses where the participant faced the relevant group difference. For example, given that each participant was placed 12 times in minorities with a group difference of 1, if a participant 'A' conformed in 3 such responses, the 'likelihood' of 'A' conforming to a group difference of 1 was considered as 25%. Moreover, we observed

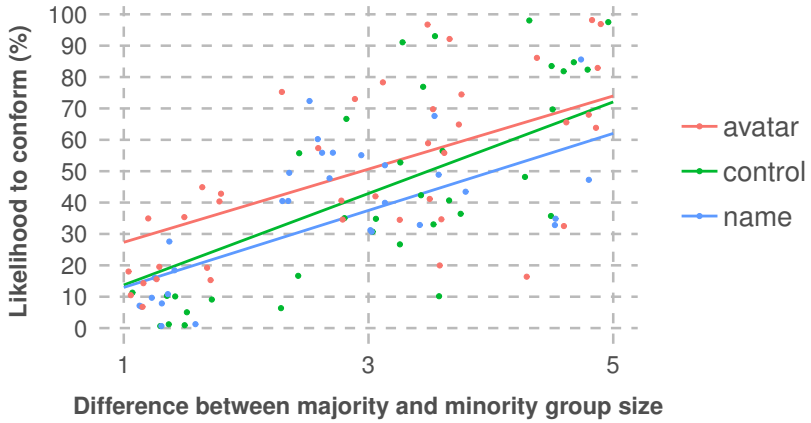

Fig. 4. The likelihood of participants conforming to the majority in the control, 'names' and 'avatars' conditions.

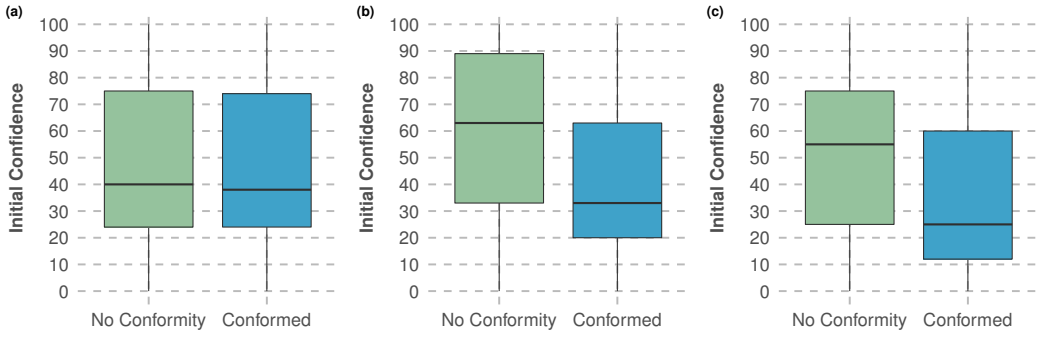

Fig. 5. Initial confidence of participants and conformity behaviour across the three conditions: (a) control, (b) names, and (c) avatars.

that the effect of group difference was strongest in the control condition (See Fig. 4), whereas in the conditions with gender cues this effect was considerably weaker.

Moreover, as the self-reported initial confidence on answers increased, participants were less likely to conform to the majority. The effect of initial confidence on conformity was strongest in the 'avatars' condition and weakest in the 'control' condition. This is illustrated in detail in Fig. 5. The confidence levels of participants in all three conditions ranged between 0 – 100 in conformity responses as well as in non-conforming responses. However, we observed differences in the median values of conforming and non-conforming responses across all three conditions. In the control condition, participants who conformed to the majority displayed a median of 38, where as those who did not conform to the majority demonstrated a median value of 40 (See Fig. 5 (a)). Similarly, we observed the median values 33 and 63 for participants of the 'names' condition who conformed and did not respectively (See Fig. 5 (b)). This trend continued in the 'avatars' condition (compared to the control), where participants who conformed to the majority displayed a median initial confidence of 25 and participants who did not conform displayed a median value of 55 (See Fig. 5 (c)). In general, our results consistently show that individuals who displayed higher confidence on their initial answers were less likely to be impacted by the majority.

5.3 Gender and Gender Cues

In the control model we observed that participants were less likely to conform on questions stereotypically perceived as being of feminine nature when compared to neutral questions. Men and women showed no statistically significant differences in conformity behaviour. However, we observed that men were less likely to conform to questions stereotypically perceived as being of masculine nature when compared to women (See Fig. 6). No similar interactions were observed between participant gender and the different question types.

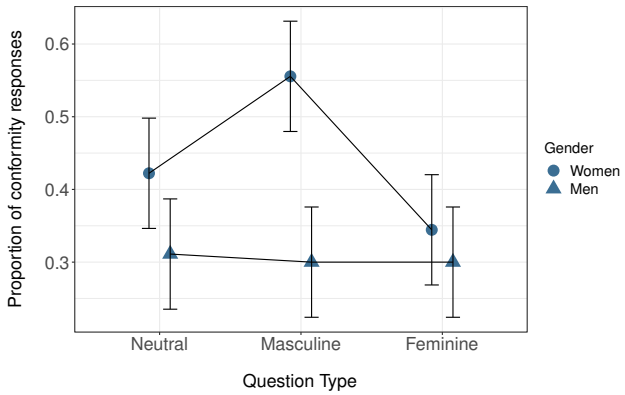

Fig. 6. Interaction between question type and participant gender in the control condition.

The 'names' model introduced gender cues to the peer answers by displaying the supposed first names of the peers to the participants. In contrast to the control model, the 'names' model suggest that participants were more likely to conform to questions stereotypically perceived as being of masculine nature than neutral questions.

As gender cues pertaining to peer answers were present in the 'names' condition, we focused on analysing any possible effects from the gender composition (operationalised by the stereotypical masculine or feminine peer names) of the majority and the minority groups on conformity behaviour. Even though we did not observe any main effects from group gender compositions, there were statistically significant interactions between participant gender, question type, and the difference between the number of stereotypical masculine and feminine names (Δ M - F) in the majority. This effect is illustrated in Fig. 7, which shows the density of conformity responses for the three question types as the difference between the number of stereotypical masculine and feminine names in the majority goes from -6 (a majority with 6 stereotypical feminine names) to +6 (a majority with 6 stereotypical masculine names). The dashed lines represent the average difference between the number of stereotypical masculine and feminine names in the majority for each question type. Negative values across the scale represent majorities with more stereotypical feminine names, while positive values represent majorities with more stereotypical masculine names.

Based on the results of our model we observed that women were more likely to conform to questions stereotypically perceived as being of masculine nature when the majority had more stereotypical masculine names than stereotypical feminine names. This is illustrated in Fig. 7 (a) by the higher density of masculine questions among the positive differences in the majority. Similarly, men found a majority with more stereotypical feminine names than stereotypical masculine names more agreeable when answering the feminine questions. Other interactions between majority gender composition, question type and participant gender were not statistically significant.

Our third model was based on the responses generated by participants in the 'avatars' condition. As in the 'names' model, we did not observe any main effects from group gender composition in the

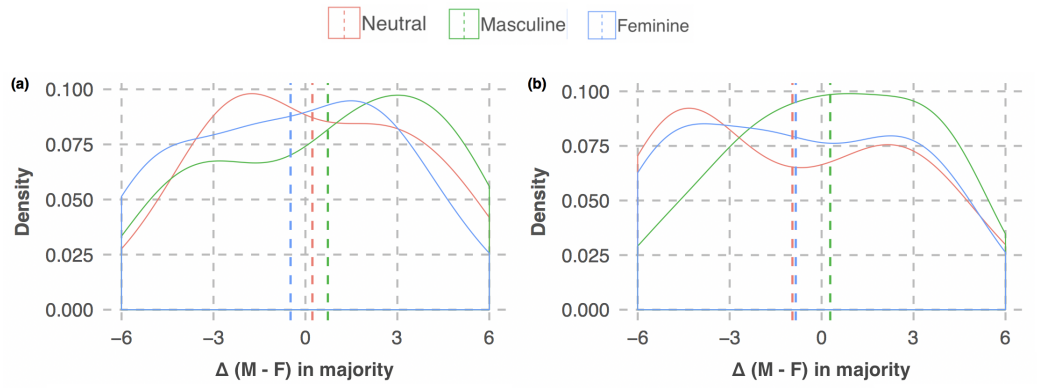

Fig. 7. Interaction between question type and difference between the number of stereotypical masculine and feminine names in the majority among (a) women and (b) men.

'avatars' model. However, our results show statistically significant interactions among the difference between the number of stereotypical masculine and feminine avatars (Δ M - F) in the majority, question type and participant gender. The effect of the aforementioned variables on conformity is illustrated in Fig. 8, and shows a similar distribution as Fig. 7.

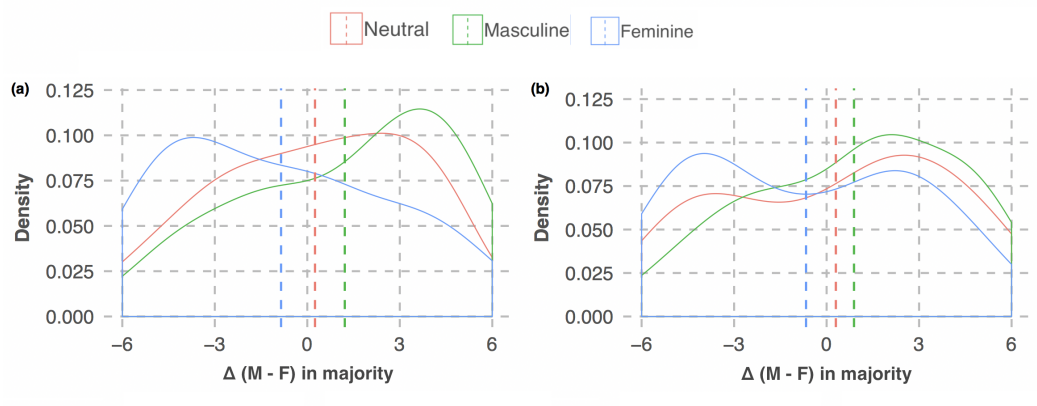

Fig. 8. Interaction between question type and difference between the number of stereotypical masculine and feminine avatars in the majority among (a) women and (b) men.

5.4 Conformity and Answer Correctness

Beyond identifying the impact of the previously mentioned determinants on conformity, we also quantify the effect of social conformity on the correctness of answers. All MCQ questions included in the quiz were objective questions with one correct answer. Moreover, since the distribution of peer answers was decided based on the participant's initial answer and aggregated results of the pilot study, we emphasise that the majority may have been positioned in correct answers as well as in incorrect answers. Thus, conforming to the majority may result in the a correct final answer or an incorrect final answer. Table 2 displays the distribution of correct and incorrect conformity responses across the three conditions.

Conformity Responses = 631					
Control = 211		**Names = 181**		**Avatars = 249**	
Correct	**Incorrect**	Correct	**Incorrect**	Correct	**Incorrect**
95	**106 (~50%)**	78	**103 (~57%)**	115	**134 (~54%)**
N = 34	N = 32	N = 24	N = 20	N = 42	N = 30
M = 33	M = 44	M = 26	M = 47	M = 44	M = 52
F = 28	F = 30	F = 28	F = 37	F = 29	F = 54

Table 2. The distribution of correct and incorrect conformity responses across the three conditions (N = Neutral questions, M = Masculine questions, F = Feminine questions).

Table 2 shows that conforming to the majority was more likely to result in an incorrect answer (>50% incorrect answers) across all three conditions. Our results also show that in the conditions which included gender cues in peer answers, there were more incorrect answers in gender-typed questions than in neutral questions. We then conducted ANOVAs for each condition, to compare group differences between the three question types. While we did not observe any significant difference among the question types in the control condition, for the 'names' and 'avatars' conditions there was a statistically significant difference in incorrect responses pertaining to the question types. We then conducted a Tukey post-hoc test that showed a significant difference between group means of neutral and questions stereotypically perceived as being of feminine nature as well as neutral and questions stereotypically perceived as being of masculine nature, in both 'names' and 'avatars' conditions (with adj. $p<0.05$ in both conditions).

5.5 Qualitative Analysis

The following qualitative analysis is based on our interview results obtained after participants completed the quiz, and aims to better understand the thought processes behind conforming or non-conforming behaviour of the participants in different situations. Three of the paper's authors were responsible for transcribing the audio recordings pertaining to the post-task interviews with the participants. We then individually applied a deductive thematic analysis [11] to the generated transcripts based on the paper's research objectives (*i.e.*, effects of determinants such as majority size and self-confidence, stereotypical thinking, and gender cues on conformity behaviour in online settings). Following this, the three authors met to discuss and identify the main themes. Next, we present the main findings of this analysis.

5.5.1 Majority Size and Confidence. We set out to confirm the current literature on social conformity regarding majority size and confidence. Our qualitative results point at these two factors repeatedly as to why our participants chose to (not) conform to the presented questions.

First, the size of the majority was also considered as a factor by many participants. When faced with a large (opposing) majority, participants were more likely to change their answer; "*When you see a significant majority, you start second-guessing. If it was something I knew 100% I would not change it. But if it was something I was very confident, but was not 100% sure, it made me second guess. When there were lots of people on the opposing majority, it made me feel that if that many selected the answer, it could be right.*" (P43). Smaller differences in the respective majority and minority were generally seen as less decisive; "*If I have two options that I am not sure about, and the feedback is usually parallel with those two, I tend to change to the majority, unless there is a difference of one.*" (P60).

Second, the participant's confidence in their answer. Naturally, high confidence led to less conforming behaviour, and low confidence resulted in more frequent answer switching. As summarised by one of our participants; "*Sometimes I got reassurance from the other answers. When I had no knowledge on the topic, I would get ideas from others. Meaning, I picked the answer that majority picked. It made me*

feel more comfortable." (P13). Similarly, participants point to specific questions to which they were certain of their answer (*e.g.*, due to personal experiences such as hobbies or cultural background) and were therefore steadfast in their answer; "*When I had the knowledge, I did not change my answer (e.g. currency of Indonesia).*" (P03). These qualitative results align with our quantitative results as well as the existing literature.

5.5.2 Gender Stereotypes. Our qualitative findings support our choice of question topics for stereotypical masculine and feminine questions, as well as neutral questions. We observe that in the considered community, participants identify sports-related questions as masculine and fashion-related questions as feminine expertise areas; "*I think generally in our society women would care more about fashion and the knowledge that comes with that. Men are more interested in a lot of different sports. With people I know, men are more interested in sports and women in fashion. I thought it could be true for more people.*" (P36). Furthermore, our participants specifically state that the gender composition of their peers affects their decision to change their answer in gender-typed questions; "*If it was a sports-related question, I will feel most comfortable not to change my answer in a group with women. And vice versa. But if the question was about geography or flags, it won't make any difference to me*" (P40). For several of our participants, the effect of gender stereotypes was stronger than that of group size. As expressed explicitly; "*If it was fashion I would look at the answer which most women have picked. I would still pick the group with more women even if they are not in the majority. Same with men for sports.*" (P27).

Some of our participants admit that their motivation is based on traditional stereotypes, but believe that these stereotypes can be used to their advantage; "*When it was a fashion related question, I chose the answer which had more women in it. [...] It is a pretty stereotypical decision, but I had a feeling that women would know more about fashion.*" (P55). Finally, even when participants believe that the question gender type did not affect their judgement, they still alluded to the stereotypical nature of masculine-feminine expertise on sports and fashion. "*I did not take the fashion/sports distribution and the gender as a relevant consideration. When we talk about fashion, it is not necessary that women or men know about it more. I know many men who don't like watching particular sports and some women do.*" (P25). The aforementioned comments were reported more or less equally among male and female participants.

5.5.3 Gender Cues. Finally, we discussed with participants assigned to the 'avatars' and 'names' conditions how they perceived their respective gender cue (*i.e.* either names or avatars) and revealed the gender cue presented to the other (non-control) condition. Participants reported that they would be more easily able to identify gender differences using a visual representation; "*I would have easily noticed the difference between female and male groups with avatars. Maybe because we are familiar with the female and male avatar representations but not with the [use of] names.*" (P05). The interview data reveals two primary motivations behind the participants' preference for avatars over names. First, participants stated that avatars are less time-consuming and more 'obvious' to identify gender based on a visual representation; "*I think avatars would be more obvious as the icons were defined as masculine and feminine. I personally struggled with the fashion questions, but it did not occur to me to look at females for fashion questions.*" (P24).

Second, a number of participants raised the fact that they might encounter names with which they are unfamiliar. Classifying names from different cultures as belonging to either a man or a woman can therefore be difficult. "*With different countries it become more difficult to identify the gender from the names. In general silhouettes are more universal.*" (P42).

Finally, we note that although a vast majority of participants prefers the use of avatars over names, two participants state that names often provide further cues; "*Names can have additional information as well. If the fashion designer was from Spain, I would choose the answers given by Spanish-like names.*" (P64). This is an interesting point, and reveals the many factors that can influence conformity.

6 DISCUSSION

6.1 Online Social Conformity

Understanding social conformity and its implications on human behaviour in online group settings is imperative to facilitate positive and unbiased interactions. Existing literature related to online social conformity reveals that conformity can have both positive and negative implications. Social conformity is seen to enable communities to establish and strengthen group norms, leading to positive contributions [64] and creating a sense of belongingness and security by encouraging acceptable conventions of behaviour [62]. On the contrary, previous work has shown that students that conform to the majority in online quizzes make more errors than students who attempted the quiz independently [9]. Moreover, Sharma and De Choudhury [62] argued that pressure to conform to group norms may cause unnecessary distress to individuals seeking support from online communities. Thus, we argue that in order to benefit from the positive outcomes of conformity while minimising its adverse effects, a thorough understanding of its determinants is needed.

This study aims to extend the existing literature by exploring gender-stereotypes related to social conformity in online settings. While existing literature focuses on the effects of participant and partner gender in online settings [41, 42], we investigated these effects in larger groups – a common occurrence in online social systems. We explored the impact of group gender distribution and participant gender on the likelihood of an individual conforming to the majority when answering stereotypical masculine and feminine questions, as well as neutral questions. We also looked at the possible effects of different gender cues in triggering stereotypical behaviour in online settings.

Our results show that despite limited social presence in online settings, individuals are sensitive to available gender cues. Moreover, such gender cues were seen to trigger stereotypical perceptions on the competency of others which ultimately led to higher conformity, especially in questions which were perceived to be stereotypically masculine or feminine. While the gender of the participant itself did not have significant main effects on conformity, we observe statistically significant interactions between group gender distribution, participant gender, and stereotypically perceived question type.

Furthermore, our results show that the likelihood of an individual conforming to the majority decreases the more confident the person is, and increases as the difference between the majority size and the minority size (group difference) increases. This is in line with literature regarding face-to-face and online social conformity [3, 13, 33, 46, 59, 60, 65]. Furthermore, we note that the effect of group difference on conformity was largest in the control and lowest in the 'avatars' condition. This implies that while group difference had significant effects on conformity its influence on conformity was higher in the absence of gender cues.

6.2 Impact of Stereotypes on Online Social Conformity

Our quantitative and qualitative results reveal that both men and women typically conformed to a majority with more masculine avatars/names in stereotypical masculine questions, and to a majority with more feminine avatars/names in stereotypical feminine questions. Similar findings were found in previous work exploring effects of partner gender on conformity [41, 42]. These results suggest that in the presence of gender cues, conformity behaviour was influenced by gender-stereotypes in addition to the usual 'informational influences'. Even though our pilot study (where men and women were seen to be equally competent in all questions) clearly rejected such stereotypes, it is noteworthy that these stereotypes manifested so strongly in our experiment.

We further note that the effect of stereotypical masculine/feminine avatars was stronger than the effect of stereotypical masculine/feminine names in triggering gender-stereotypical thinking. Participants identified avatars to be more straight-forward, making the gender distribution of answers easier to interpret. These observations confirm existing literature on how individuals derive perceptions of the gender of their online peers [15, 41, 42, 45], and how some cues may have more influence in triggering stereotypes than others [43].

The use of objective questions enabled us to quantify the effects of conformity driven by gender-stereotypes on answer correctness. Our results show that conformity resulted in more incorrect answers across the three conditions, despite the majority being placed in both correct and incorrect answers throughout the quiz. The introduction of gender cues resulted in more incorrect answers for stereotypical masculine and feminine questions, as compared to the control condition. Thus, we show that gender cues encourage individuals to conform to incorrect answers more frequently, especially in topics that can trigger a biased response. Since in online settings participants are naturally susceptible to higher 'informational influences' (*e.g.*, groups of students answering an online quiz as given in [9]), it is crucial to consider what user information should be available to others.

Moreover, we emphasise that gender is only one dimension of a person's identity and that other aspects such as culture, race, age, and ethnicity can also be relevant in a given situation [12]. This study was designed to investigate the effects of gender stereotypes on conformity, as gender has been shown to trigger stereotypical responses in offline settings [22–24]. We deliberately avoided other aspects that could potentially lead to stereotypes as it would overly complicate the study and lead to confounding effects. We chose stereotypical gendered silhouette avatars and names, with minimum user cues (*i.e.,* perceived gender of user) in an attempt to minimise the potential impact of other user traits such as race, ethnicity, and age which could potentially be inferred from richer cues. Similarly, the quiz questions were also chosen to specifically trigger gender stereotypes.

Thus, this work was intended to lay the necessary ground-work for future work exploring possible implications of other commonly observed stereotype-inducing factors on online social conformity. For example, work by Kumar [38] shows that in face-to-face groups participants are more likely to conform to older confederates than to younger confederates in estimation tasks. Moreover, although we selected a set of culturally-similar names, participants highlighted that first names of peers could potentially introduce cultural biases. For example, if the question was related to a particular country or region, peer names perceived to originate from this area could be perceived as more appealing than others.

6.3 Implications for Design

The findings of this study establish that, despite a reduced social presence in online settings, individuals stereotypically perceive others' competency based on available gender cues. Moreover, such gender stereotypical perceptions were seen to influence the conformity behaviour of users. While conformity may be seen as a positive outcome in settings where adopting group norms are encouraged [62], it is not desired when user decisions are unnecessarily influenced by gender stereotypes, as shown in our answer correctness analysis. Thus, we present the following design recommendations with regard to gender cues when designing online group settings, where user decisions may be negatively influenced by others.

6.3.1 Presence of Gender Cues. Recent literature has questioned whether gender cues (such as names and avatars) should be visible to others, and if so, when and how should they be visible [36]. Our findings indicate that basic cues (such as names) are sufficient to elicit gender-stereotyping and conformity, with a richer cue (avatar) heightening this behaviour. Furthermore, almost every online social platform allows users to upload their own photographs to be used as profile pictures in addition to the default avatars that we considered in this study. Previous work has established that photographs of users can act as strong gender cues [6, 7], meaning that it is probable that the gender-stereotypical conformity observed in our work would be heightened. Thus, a designer should carefully consider whether collecting and displaying gender cues is relevant and value-adding from the perspective of users as well as the platform. If unnecessary cues are visible, users may miss other important information and act based on stereotypical perceptions.

While our results recommend against using obvious gender cues (such as binary-gendered avatars) in online group settings to reduce gender-stereotypical perceptions and conformity, we acknowledge that removing all indications of gender may not be easily achievable in an online group environment.

Literature suggests that assumptions of peer gender in online settings may be derived based on perceived gender difference in linguistic use [32, 61] and gender disparities resulted by platform infrastructure [27], even when user information is not explicitly available. Thus, in addition to the cues discussed in this paper, designers should be mindful about the impact of other possible cues that may elicit similar gender stereotypical behaviour.

However, it is also important to acknowledge that in certain online settings user cues can be important to create trust among users and a sense of belonging within the community [47]. As such, many websites assign default user avatars upon registration, which can be problematic if these avatars contain gender cues. As shown in our study, users can stereotypically infer the competency of their peers based on gender cues (avatars and names), and display gender-biased conformity behaviour. For example, Facebook's use of user names and default binary-gendered avatars is likely to elicit gender-biased conformity in how users discuss stereotypically perceived masculine/feminine topics on the platform. A similar effect may occur in Goodreads, a platform which also uses names and binary-gendered avatars by default, and has discussion groups to allow users to review and discuss books (which can be pertaining to topics stereotypically perceived as masculine or feminine) with others in the community.

Moreover, while several platforms adopt gender-neutral default avatars, literature suggests that people frequently tend to perceive such avatars as masculine [5]. Supposed gender-neutral avatars are currently used in SAP Litmos, TalentLMS and Docebo (the top three most used Learning Management Systems in the world as of June 2019 [1]) as shown in Fig. 9, which could suggest 'men' as the default user group of the platform and thereby disregarding other gender identities. In addition, some users of these platforms may decide to upload their photographs, further increasing the likelihood of stereotype-based conformity. Given that these platforms are used to facilitate learning, our findings have important and far-reaching implications.

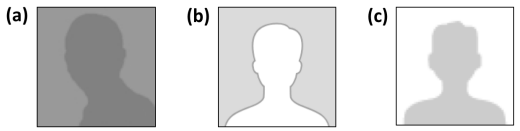

Fig. 9. Default avatars used in (a) SAP Litmos, (b) TalentLMS and (c) Docebo.

Critically, our findings establish that user representations without gender cues (the study's control condition) reduced the likelihood of gender-biased conformity. Based on these results, if avatars (or other cues) are to be used in platforms where gender-biased conformity can be detrimental, we recommend using default alternatives clearly devoid of gender cues, such as initials representing user name (*e.g.* Google), identicons (*e.g.* Github) or site specific avatars (*e.g.* Slack), minimising the possibility of triggering gender stereotypical perceptions and behaviour.

6.4 Limitations

We note the following limitations in our study. Our sample only included participants who self-disclosed their gender-identity as either men or women, and none of the participants openly identified as trans or cisgender. It is worth noting that this study is premised on a traditional gender binary model, in which gendered senses of self fall into two clearly discernible categories. In practice, gender is far more complex than this: what it means to be gendered in a particular way varies from place to place, in different times, and is heavily influenced by race, age and other factors. As such, our paper should be taken as a first step, rather than as broadly applicable to 'gender' in its entirety. Moreover, even though our participants came from diverse educational levels and backgrounds, they represent a predominantly computer-literate population. Thus, further work may be required to ensure whether these observations can be generalised to a wider population.

While within the community considered for this study (a Western country), the chosen topics and names were appropriate to elicit gender stereotypes (as evident by our quantitative and qualitative results), they may not generate similar results cross-culturally due to different cultural norms. Therefore, we encourage future research to extend our work by investigating different communities following a similar pilot test (as explained in Section 3.1) to ensure that chosen topics and names are in line with the gender perceptions of the targeted community.

Moreover, to exclude confounding variables such as participant assertiveness, we deployed our study in a controlled environment (one participants at a time). This is atypical for many online settings. We aim to explore the effect of synchronous interactions in an online setting in future work. Furthermore, the quiz we deployed utilised only objective questions as we aimed to investigate consequences of conformity in terms of answer correctness. Future research could expand our findings to subjective questions to explore the possible effects of gender-stereotypes on conformity.

7 CONCLUSION

Social conformity is a powerful social phenomenon in which individuals adjust their behaviour and opinions to agree with an opposing majority. While previous work has investigated conformity and its determinants in online group settings, the effects of gender and related stereotypes on online social conformity remain underexplored. This study investigated the effects of group gender composition and participant gender across both neutral and stereotypically perceived masculine (sports) and feminine (fashion) questions on conformity in an online quiz. We compared results across three conditions to evaluate the strength of different gender cues: a control condition where participants were oblivious to the gender of their peers; a condition displaying stereotypical masculine and feminine names of their peers; and finally a condition displaying peers using stereotypical masculine and feminine silhouette avatars. Our findings establish that individuals are receptive to subtle gender cues available in online group settings, and make (often incorrect) assumptions of their peers' competency based on prevailing gender-stereotypes, especially when making decisions in uncertain situations.

We conclude our work with a discussion on the implications of our findings in designing for online group settings, with minimum exposure to stereotypical gender biases. We suggest that designers carefully consider whether displaying gender and other user cues is relevant and value-adding from the perspective of end-users as well as the platform. We recommend against the use of gender cues such as binary-gendered avatars (especially in situations where group members could perceive the competency of others based on gender). Instead, we support using alternatives devoid of gender cues such as identicons, avatars with user initials, or site specific avatars, to ensure unbiased discussion and decision making. We encourage future work to explore similar effects on online social conformity, with regard to other aspects of a person's identity that can lead to stereotype-based conformity, such as age, race, and ethnicity.

REFERENCES

[1] Louie Andre. 2019. Finance Online: List of Top LMS Software Companies of 2019. https://financesonline.com/top-20-lms-software-companies

[2] Solomon E Asch. 1951. *Groups, leadership and men.* Carnegie Press, Oxford, England, Chapter: Effects of group pressure upon the modification and distortion of judgements, 177–190.

[3] Solomon E Asch. 1955. Opinions and social pressure. *Scientific American* 193, 5 (1955), 31–35.

[4] Erin Ash. 2016. Priming or Proteus Effect? Examining the Effects of Avatar Race on In-Game Behavior and Post-Play Aggressive Cognition and Affect in Video Games. *Games and Culture* 11, 4 (2016), 422–440.

[5] April H. Bailey and Marianne LaFrance. 2016. Anonymously male: Social media avatar icons are implicitly male and resistant to change. *Cyberpsychology* 10, 4 (2016), 1 – 14.

[6] Susan A Banducci, Jeffrey A Karp, Michael Thrasher, and Colin Rallings. 2008. Ballot photographs as cues in low-information elections. *Political Psychology* 29, 6 (2008), 903–917.

[7] Andrew W Barrett and Lowell W Barrington. 2005. Is a picture worth a thousand words? Newspaper photographs and voter evaluations of political candidates. *Harvard International Journal of Press/Politics* 10, 4 (2005), 98–113.

[8] Douglas Bates, Martin Mächler, Ben Bolker, and Steve Walker. 2015. Fitting Linear Mixed-Effects Models Using lme4. *Journal of Statistical Software* 67, 1 (2015), 1–48.

[9] Tanya Beran, Michelle Drefs, Alyshah Kaba, Noof Al Baz, and Nouf Al Harbi. 2015. Conformity of responses among graduate students in an online environment. *The Internet and Higher Education* 25 (2015), 63–69.
[10] Benjamin M. Bolker, Mollie E. Brooks, Connie J. Clark, Shane W. Geange, John R. Poulsen, M. Henry H. Stevens, and Jada-Simone S. White. 2009. Generalized linear mixed models: a practical guide for ecology and evolution. *Trends in Ecology & Evolution* 24, 3 (2009), 127–135.
[11] Virginia Braun and Victoria Clarke. 2006. Using thematic analysis in psychology. *Qualitative Research in Psychology* 3, 2 (2006), 77–101.
[12] Samantha Breslin and Bimlesh Wadhwa. 2014. Exploring Nuanced Gender Perspectives Within the HCI Community. In *Proceedings of the India HCI 2014 Conference on Human Computer Interaction (IndiaHCI '14)*. ACM, New York, NY, USA, Article 45, 10 pages.
[13] Jennifer D Campbell, Abraham Tesser, and Patricia J Fairey. 1986. Conformity and attention to the stimulus: Some temporal and contextual dynamics. *Journal of Personality and Social Psychology* 51, 2 (1986), 315–324.
[14] Linda L Carli. 1989. Gender differences in interaction style and influence. *Journal of Personality and Social Psychology* 56, 4 (1989), 565–576.
[15] Emily Christofides, Towhidul Islam, and Serge Desmarais. 2009. Gender stereotyping over instant messenger: The effects of gender and context. *Computers in Human Behavior* 25, 4 (2009), 897–901.
[16] Robert B Cialdini. 2001. Harnessing the science of persuasion. *Harvard Business Review* 79, 9 (2001), 72–81.
[17] Robert B Cialdini and Noah J Goldstein. 2004. Social influence: Compliance and conformity. *Annu. Rev. Psychol.* 55 (2004), 591–621.
[18] Marco Cinnirella and Ben Green. 2007. Does 'cyber-conformity' vary cross-culturally? Exploring the effect of culture and communication medium on social conformity. *Computers in Human Behavior* 23, 4 (2007), 2011–2025.
[19] Karen M Cornetto and Kristine L Nowak. 2006. Utilizing usernames for sex categorization in computer-mediated communication: Examining perceptions and accuracy. *CyberPsychology & Behavior* 9, 4 (2006), 377–387.
[20] Morton Deutsch and Harold B Gerard. 1955. A study of normative and informational social influences upon individual judgment. *The Journal of Abnormal and Social Psychology* 51, 3 (1955), 629–636.
[21] Vitaly J Dubrovsky, Sara Kiesler, and Beheruz N Sethna. 1991. The equalization phenomenon: Status effects in computer-mediated and face-to-face decision-making groups. *Human-Computer Interaction* 6, 2 (1991), 119–146.
[22] Alice H Eagly. 1983. Gender and social influence: A social psychological analysis. *American Psychologist* 38, 9 (1983), 971–981.
[23] Alice H Eagly and Carole Chrvala. 1986. Sex differences in conformity: Status and gender role interpretations. *Psychology of Women Quarterly* 10, 3 (1986), 203–220.
[24] Alice H Eagly and Wendy Wood. 1985. Gender and influenceability: Stereotype versus behavior. In *Women, gender, and social psychology*. Erlbaum, Hillsdale, NJ, USA, 225–256.
[25] Susan Alizadeh Fard. 2010. Effect of gender and social status on conformity. *Psychological Research* 13, 1 (2010), 30 – 50.
[26] Katrina Fong and Raymond A Mar. 2015. What does my avatar say about me? Inferring personality from avatars. *Personality and Social Psychology Bulletin* 41, 2 (2015), 237–249.
[27] Heather Ford and Judy Wajcman. 2017. 'Anyone can edit', not everyone does: Wikipedia's infrastructure and the gender gap. *Social studies of science* 47, 4 (2017), 511–527.
[28] Jorge Goncalves, Vassilis Kostakos, and Jayant Venkatanathan. 2013. Narrowcasting in Social Media: Effects and Perceptions. In *Proceedings of the 2013 IEEE/ACM International Conference on Advances in Social Networks Analysis and Mining (ASONAM '13)*. ACM, New York, NY, USA, 502–509.
[29] Victoria Groom, Jeremy N Bailenson, and Clifford Nass. 2009. The influence of racial embodiment on racial bias in immersive virtual environments. *Social Influence* 4, 3 (2009), 231–248.
[30] Joseph F Hair, William C Black, Barry J Babin, Rolph E Anderson, and RL Tatham. 2010. *Multivariate Data Analysis*. Pearson, New Jersey, NJ, USA.
[31] Eszter Hargittai and Steven Shafer. 2006. Differences in actual and perceived online skills: The role of gender. *Social Science Quarterly* 87, 2 (2006), 432–448.
[32] Libby Hemphill and Jahna Otterbacher. 2012. Learning the Lingo?: Gender, Prestige and Linguistic Adaptation in Review Communities. In *Proceedings of the ACM 2012 Conference on Computer Supported Cooperative Work (CSCW '12)*. ACM, New York, NY, USA, 305–314.
[33] Chester A. Insko, Richard H. Smith, Mark D. Alicke, Joel Wade, and Sylvester Taylor. 1985. Conformity and Group Size: The Concern with Being Right and the Concern with Being Liked. *Personality and Social Psychology Bulletin* 11, 1 (1985), 41–50.
[34] Richard A. Johnson and Gary I. Schulman. 1989. Gender-Role Composition and Role Entrapment in Decision-Making Groups. *Gender and Society* 3, 3 (1989), 355–372.
[35] Simon Kemp. 2019. Digital 2019: Global Internet Use Accelerates. https://wearesocial.com/blog/2019/01/digital-2019-global-internet-use-accelerates
[36] Os Keyes. 2018. The Misgendering Machines: Trans/HCI Implications of Automatic Gender Recognition. *Proc. ACM Hum.-Comput. Interact.* 2, CSCW, Article 88 (Nov. 2018), 22 pages.
[37] Sara Kiesler, Jane Siegel, and Timothy W McGuire. 1984. Social psychological aspects of computer-mediated communication. *American Psychologist* 39, 10 (1984), 1123–1134.

[38] Jitendra Kumar. 1983. Conformity behavior as a function of confederates' age and size of the confederate group. *Personality Study & Group Behaviour* 3 (1983), 69–73.
[39] Lieve Laporte, Christof van Nimwegen, and Alex J. Uyttendaele. [n. d.]. Do People Say What They Think: Social Conformity Behavior in Varying Degrees of Online Social Presence. In *Proceedings of the 6th Nordic Conference on Human-Computer Interaction: Extending Boundaries (NordiCHI '10)*. ACM, New York, NY, USA, 305–314.
[40] Eun-Ju Lee. 2003. Effects of 'gender' of the computer on informational social influence: the moderating role of task type. *International Journal of Human-Computer Studies* 58, 4 (2003), 347–362.
[41] Eun-Ju Lee. 2004. Effects of gendered character representation on person perception and informational social influence in computer-mediated communication. *Computers in Human Behavior* 20, 6 (2004), 779–799.
[42] Eun-Ju Lee. 2007. Wired for gender: Experientiality and gender-stereotyping in computer-mediated communication. *Media Psychology* 10, 2 (2007), 182–210.
[43] Eun-Ju Lee and Clifford Nass. 2002. Experimental tests of normative group influence and representation effects in computer-mediated communication: When interacting via computers differs from interacting with computers. *Human Communication Research* 28, 3 (2002), 349–381.
[44] John M Levine. 1999. Solomon Asch's legacy for group research. *Personality and Social Psychology Review* 3, 4 (1999), 358–364.
[45] Wendy Liu and Derek Ruths. 2013. What's in a name? Using first names as features for gender inference in twitter, In 2013 AAAI Spring Symposium Series. *AAAI Spring Symposium - Technical Report* SS-13-01, 10–16.
[46] Paul Benjamin Lowry, Tom L Roberts, Nicholas C Romano Jr, Paul D Cheney, and Ross T Hightower. 2006. The impact of group size and social presence on small-group communication: Does computer-mediated communication make a difference? *Small Group Research* 37, 6 (2006), 631–661.
[47] Michael Luca. 2017. Designing online marketplaces: Trust and reputation mechanisms. *Innovation Policy and the Economy* 17, 1 (2017), 77–93.
[48] Misa Maruyama, Scott P. Robertson, Sara Douglas, Roxanne Raine, and Bryan Semaan. 2017. Social Watching a Civic Broadcast: Understanding the Effects of Positive Feedback and Other Users' Opinions. In *Proceedings of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing (CSCW '17)*. ACM, New York, NY, USA, 794–807.
[49] Misa T. Maruyama, Scott P. Robertson, Sara K. Douglas, Bryan C. Semaan, and Heather A. Faucett. 2014. Hybrid Media Consumption: How Tweeting During a Televised Political Debate Influences the Vote Decision. In *Proceedings of the 17th ACM Conference on Computer Supported Cooperative Work & Social Computing (CSCW '14)*. ACM, New York, NY, USA, 1422–1432.
[50] Kimberly Matheson. 1991. Social cues in computer-mediated negotiations: Gender makes a difference. *Computers in Human Behavior* 7, 3 (1991), 137–145.
[51] Kimberly Matheson and Mark P Zanna. 1990. Computer-mediated communications: The focus is on me. *Social Science Computer Review* 8, 1 (1990), 1–12.
[52] Katelyn YA McKenna and Amie S Green. 2002. Virtual group dynamics. *Group Dynamics: Theory, Research, and Practice* 6, 1 (2002), 116–127.
[53] Kristine L Nowak and Christian Rauh. 2005. The influence of the avatar on online perceptions of anthropomorphism, androgyny, credibility, homophily, and attraction. *Journal of Computer-Mediated Communication* 11, 1 (2005), 153–178.
[54] Tom Postmes and Russell Spears. 2002. Behavior online: Does anonymous computer communication reduce gender inequality? *Personality and Social Psychology Bulletin* 28, 8 (2002), 1073–1083.
[55] Tom Postmes, Russell Spears, and Martin Lea. 2000. The formation of group norms in computer-mediated communication. *Human Communication Research* 26, 3 (2000), 341–371.
[56] Tom Postmes, Russell Spears, Khaled Sakhel, and Daphne De Groot. 2001. Social influence in computer-mediated communication: The effects of anonymity on group behavior. *Personality and Social Psychology Bulletin* 27, 10 (2001), 1243–1254.
[57] Stephen D Reicher, Russell Spears, and Tom Postmes. 1995. A social identity model of deindividuation phenomena. *European Review of Social Psychology* 6, 1 (1995), 161–198.
[58] Bernardo Reynolds, Jayant Venkatanathan, Jorge Gonçalves, and Vassilis Kostakos. 2011. Sharing Ephemeral Information in Online Social Networks: Privacy Perceptions and Behaviours. In *Human-Computer Interaction – INTERACT 2011*, Pedro Campos, Nicholas Graham, Joaquim Jorge, Nuno Nunes, Philippe Palanque, and Marco Winckler (Eds.). Springer Berlin Heidelberg, Berlin, Heidelberg, 204–215.
[59] Michael Rosander and Oskar Eriksson. 2012. Conformity on the Internet–The role of task difficulty and gender differences. *Computers in Human Behavior* 28, 5 (2012), 1587–1595.
[60] Leon A Rosenberg. 1963. Conformity as a function of confidence in self and confidence in partner. *Human Relations* 16, 2 (1963), 131–139.
[61] Victor Savicki, Merle Kelley, and E Oesterreich. 1999. Judgments of gender in computer-mediated communication. *Computers in Human Behavior* 15, 2 (1999), 185–194.
[62] Eva Sharma and Munmun De Choudhury. 2018. Mental Health Support and Its Relationship to Linguistic Accommodation in Online Communities. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems (CHI '18)*. ACM, New York, NY, USA, Article 641, 13 pages.

[63] David J Stang. 1976. Ineffective deception in conformity research: Some causes and consequences. *European Journal of Social Psychology* 6, 3 (1976), 353–367.
[64] Abhay Sukumaran, Stephanie Vezich, Melanie McHugh, and Clifford Nass. 2011. Normative Influences on Thoughtful Online Participation. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '11)*. ACM, New York, NY, USA, 3401–3410.
[65] Abraham Tesser, Jennifer Campbell, and Susan Mickler. 1983. The role of social pressure, attention to the stimulus, and self-doubt in conformity. *European Journal of Social Psychology* 13, 3 (1983), 217–233.
[66] Paul Wallace and James Maryott. 2009. The impact of avatar self-representation on collaboration in virtual worlds. *Innovate: Journal of Online Education* 5, 5 (2009).
[67] Wendy Wood and Stephen J Karten. 1986. Sex differences in interaction style as a product of perceived sex differences in competence. *Journal of Personality and Social Psychology* 50, 2 (1986), 341–347.
[68] Seung-Chul Yoo, J.F. Pena, and M.E. Drumwright. 2015. Virtual shopping and unconscious persuasion: The priming effects of avatar age and consumers' age discrimination on purchasing and prosocial behaviors. *Computers in Human Behavior* 48 (2015), 62 – 71.