The evolution of ingroup bias in a dynamic experimental environment: toward a social psychology of movement.

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Abstract

This article reports the use of a new experimental technology (VIAPPL, Virtual Interaction APPLication) that allows researchers to observe the evolution of social structures (such as norms, networks and identities), interaction patterns, and social outcomes like exclusion, inequality and ingroup favoritism. Recent developments in social psychology have highlighted the strategic nature of social action, the emergence of social identities and norms in interaction, and the need for dynamic explanations of the conservation and change of social structures and outcomes. What has been lacking is the experimental technology for conducting such research. This article reports a series of replications of the minimal group studies that were conducted on the VIAPPL platform. The results confirmed that social categorization produces ingroup bias; that the norm of ingroup bias strengthens over time; and showed that ingroup bias is stronger among low status than high status groups, but that this discrepancy decreases over time. In addition, social network analysis generated novel insights into the psychological properties of the minimal group situation. Most importantly, it showed that levels of ingroup bias varied substantially across situations that emerged from the activity of the participants over the course of the experiment. This occurred because participants needed to make complex choices between competing norms for action (including ingroup-giving, reciprocation, re-giving, fairness, and self-giving). The action choices that were made, individually and collectively, were affected by situational demands, obligations and emergent norms, all of which were themselves produced in the course of interaction.

Keywords: experimentation; minimal group studies; VIAPPL; ingroup bias; evolution

"I do not portray being: I portray passing" (Michel de Montaigne)

Reicher and Haslam (2013) have challenged us to reimagine social psychology as a 'science of movement'. By this they mean a science that appreciates how both social stability and change are produced in the cut and thrust of daily life. It is a revolutionary project because the discipline's success in demonstrating the normative and situational determinants of behavior has resulted in a "conformity bias" in which social psychologists treat human beings as "somehow programmed for conformity" (Haslam & Reicher, 2012, p. 1). This bias has produced theories of social influence that lack dynamism, focusing on the one-way influence of norms and identities on human action rather than the countervailing creative influence of human action on situations.

Reicher & Haslam (2013) argue that this orientation was propagated by two foundational experiments in the discipline – namely, Zimbardo's prison experiment and Milgram's obedience studies – and spread throughout the discipline and its folk law by means of undergraduate textbooks. Milgram's experiments make shocking reading because they reveal how ordinary people can be transformed and led to act in cruel and inhumane ways, administering lethal electric shocks to helpless 'learners' on the instructions of an experimenter (Milgram, 1963). Zimbardo's prison experiment went even further, showing how situations could shape behavior with little overt pressure from an authority. Once student volunteers randomly assigned to be 'guards' were wearing their uniforms they treated their 'prisoner' peers increasingly cruelly, while the 'prisoners' became progressively powerless and distressed (Haney, Banks, & Zimbardo, 1973). These unfolding interactions in that Stanford basement have generally been interpreted as revealing the powerful influence of social settings on behavior. Both of these studies teach the same lesson: social situations have the power to elicit conformity, transforming participants into passive 'victims' who will suspend their morality and reasoning rather than resist.

Reicher and Haslam (2013) argue, however, that this interpretation may be partly attributable to conformity *bias*. Milgram (1974) theorized that his experimental participants entered an "agentic state", ceding responsibility for their actions, acting out of a sense of obligation, and complying with the instructions of the authority figure. However, Reicher, Haslam & Smith (2012) suggest that Milgram had to ignore certain aspects of his data to draw this conclusion. Most notably, every time the experimenter ordered compliance – using the prod, "You have no other choice teacher, you must continue" – the participants resisted, saying something like "Hell, no I don't have to continue" (cf. Burger, 2009). But Milgram ignored this evidence of disobedience and resistance. Rather than ceding responsibility, Milgram's participants can be seen acting as moral citizens "torn between two competing voices that are vying for their attention and making contradictory demands on them": the voice of the experimenter and the voice of the learner (Reicher, Haslam & Smith, 2012, p. 318). In choosing one over the other, the participants were not only acting as moral beings, they were also acting as independent agents who have the power to shape the situation. This interpretation opens the way for considering the experiment as a dynamic situation that is not yet fully formed, but is open to construction by the participants.

The participants in Zimbardo's prison also had the power to affect the situation. For example, Dave Eshelman, the most abusive of the guards, recalls that

> What came over me was not an accident. It was planned. I set out with a definite plan in mind, to try to force the action, force something to happen, so that the researchers would have something to work with. After all, what could they possibly learn from guys sitting around like it was a country club? So I consciously created this persona I was kind of running my own experiment in there, by saying, "How far can I push these things and how much abuse will these

> people take before they say, 'knock it off?'" But the other guards didn't stop me. They seemed to join in. They were taking my lead. Not a single guard said, "I don't think we should do this." (Ratnesar, 2011, par. 31)

Zimbardo and his colleague interpreted their results as demonstrating that "situations can exert powerful influences over individuals" and argued that interpretation should best "start with a situational analysis and yield to the dispositional only when the situational fails to do a causal job" (Zimbardo, Maslach, & Haney, 2000). However, Eshelman's experience suggests individuals can also exert powerful effects on situations and that situations evolve dynamically as a product of interaction between the participants.

These studies remind us that participants, like experimenters, actively construct the experimental situation and that this agency is an integral part of the social psychological phenomena that we want to study. In this article we will describe an experimental technology – the Virtual Interaction APPLication (VIAPPL) – that places participants within an experimental situation that provides information and affordances for action but that also requires creative action from participants who progressively and collectively redefine the situation through their interaction. The design of the technology takes its inspiration from work that has been concerned with the way norms and identities emerge from collective action inside evolving situations (e.g., Drury & Reicher, 2000; Postmes, Haslam & Swaab, 2005; Klein, Spears & Reicher, 2007). By making visible the two-way channels of social influence of situations on people and people on situations, VIAPPL helps us realize a social psychology that is a science of movement.

Naturalizing conformity in experimental design

Whereas Reicher and Haslam (2013) attribute the naturalization of conformity to theoretical biases – the way researchers develop hypotheses, interpret their data, and judge the relevance of their experiments – in this article we also consider how experimental design and the logic and practice of experimental control have contributed to this view. The weak control and the presence of interaction in the foundational experiments that Reicher and Haslam review make them ideal for showing that participants do not always obediently conform to situational norms and experimenter expectations. In their interaction in the experimental situation, participants can be observed contesting norms and expectations, re-making the situation, and acting in ways that were not anticipated by the experimenters. The experiments were thus liable to run out of control. Participant interactions in Zimbardo's study led to the emergence of unanticipated violent clashes between 'guards' and 'prisoners' that forced him to conclude his experiments early (Zimbardo, Maslach, & Haney, 2000). Similarly, Sherif's early summer camp studies had to be abandoned because the participants entered into conflict with the experimenters rather than with each other (Billig, 1976).

Experimental technology was soon redesigned as researchers became aware of demand characteristics (Orne, 1962) and experimenter effects (Rosenthal, 1964). Not only could social interaction produce unanticipated outcomes, but – even worse – it could result in researchers accepting mistaken hypotheses. Experimenter expectancy effects, for example, could lead "experimenters to obtain results they expect, not simply because they have correctly anticipated *nature's response* but rather because they have helped to shape that response through their expectations" (Rosenthal & Rubin, 1978, p. 377; our emphasis).

Researchers responded by improving their methods to increase experimental control by, amongst other things: limiting the ability of participants to make unanticipated meanings of psychometric measures,

with idiosyncratic responses being interpreted in terms of measurement (un)reliability; making manipulation checks *de rigeur* to ensure that participants who re-constructed the experimental situation in unexpected ways could be excluded; and limiting social interaction in the experimental situation, either with the experimenter or fellow participants. Of course, increased experimental control limits the ability for participants to behave in unexpected or creative ways, thus allowing researchers to treat their responses as 'nature's response' to the experimental situation.

Similar shifts occurred in the operationalization of dependent variables. In many of the early seminal studies, dependent variables were embedded in action and interaction, such as the decision to comply (or not) the experimenter in Milgram's study (Milgram, 1963), declarations of line-length in the presence of dissenting peers (Asch, 1951), the interactions among children on summer camp (Sherif, 1958), or the longitudinal outcomes in a prison simulation (Haney, Banks, & Zimbardo, 1973). Largely in search of rigor, the field is now dominated by more overtly valid and reliable dependent measures, such as self-report or implicit measures of cognitions and emotions. Where behaviour is measured, it is usually achieved with self-report measures of what participants have done, or would do, in social situations.

These technological advances have allowed researchers to draw more definitive conclusions about how experimental situations affect participants' responses; but they have also helped to naturalize the idea that situations affect people, rather than vice versa. The combination of strict experimental control, cross-sectional designs and rigid measures make it very difficult indeed to observe participants' social agency or creativity. Tajfel's (1972) classic paper *Experiments in a Vacuum* bewailed the consequences of such experimental technology. He argued that it obscured the two-way interactional nature of social influence, in which "the social setting of intergroup relations contributes to making the individuals what they are and they in turn produce this social setting; they and it develop and change symbiotically." (p.

95). According to Tajfel (1972), the social motive to behave appropriately underpinned both attempts to conform to situational demands and to "change, reform or revolutionize" a situation that interfered with the possibility of acting appropriately (p. 101). The problem was that experimental technology facilitated the one channel of influence at the expense of the other, making it difficult for participants to have a part in constructing the experimental situation.

The social psychology of 'movement'

Reicher and Haslam's (2013) call for social psychology as a science of movement comes in the wake of a series of efforts to study and theorize the dynamic and emergent nature of social phenomena such as identities and norms that are often treated as static experimental conditions. Reicher's (1984, 1996) early work on crowds showed how the crowd situation and the collective identities that drive collective action emerge together in the evolving interaction; and these ideas have been systematized in the elaborated social identity theory of social change (Drury & Reicher 2000, 2009). For example, Drury, Reicher and Stott (2003) showed how perceived heavy handed action by police produced an emergent shared identity among two disparate groups of protestors – middle class Wanstead residents and environmental activists who were earlier described by one resident as "people straggling around town in dreadlocks and very very tatty boots" (p. 196). Concurrently, locals' previously respectful attitude toward police authority was eroded as police were seen to be treating protesters without differentiation, as if they were all football hooligans. A new social reality was being produced as the crowd and authorities interacted; new identities were brought into being as old prejudices receded and new ones arose.

The social identity model of deindividuation effects (SIDE) has also evolved to explain the way people actively construct social situations. Initially, the model was developed to explain social influence in crowds and situations like Zimbardo's prison study in terms of the emergence of social identity rather than the loss of a sense of self (Reicher, Spears & Postmes, 1995). People's behavior in such situations was affected by these emergent social cognitions and collective self-perceptions, but it was also affected by the possibility of audience evaluation, which strengthened the normatively regulated nature of social behavior. In addition to the cognitive impact of identity salience that social situations provided, there was a "strategic side of SIDE" that could explain the emergence of norms and extreme or antisocial behaviors as individuals strategically expressed their identity in view of audiences (Spears & Postmes, 2014).

Both of these literatures anticipate the evolution of social situations and the emergence of norms and identities in collective interactions. They treat each individual action as an "identity performance" that is not only sensitive to the emerging norm, but also plays a part in constructing the norm as it strategically seeks to mobilize audiences to adopting the behavior (Klein, Spears & Reicher, 2007). By pursuing such reasoning, Postmes, Haslam & Swaab (2005) develop an interactive model of identity formation in which social identity shapes individual behavior in a deductive, top-down manner, but where social identity is itself formed in an inductive bottom-up manner from the behavior of individuals within the group.

This work provides a foundation for a social psychology of movement that can explain both stability and change in social structures, processes and outcomes. It anticipates that individual actions will be regulated by social identities and norms, and that these can act as forces towards conformity and ultimately social stability. On the other hand, collective action is simultaneously productive of new norms and identities, as individuals might act in ways that resist or redefine these structures and

thereby fashion social change. These countervailing channels of social influence shape interaction as it unfolds over time, reproducing social situations or allowing new norms and identities to emerge as situations evolve. In either case, later actions are shaped by earlier ones in unfolding situations that lead interaction along unspecified paths to produce potentially novel and unexpected outcomes.

The challenge is how to allow this dynamic interplay to be manifest in controlled experimental situations and how to observe it. Crowd research that has been informed by the elaborated social identity theory of social change has relied exclusively on qualitative investigations and reconstructions of dynamic process and emergent norms and identities. Haslam and Reicher's (2007) reconstruction of Zimbardo's prison experiment allowed identities and norms to emerge in interaction rather than being "mechanically invoked for experimental purposes" (p. 126). However, they conceded that their findings were limited by a case study methodology that lacked experimental control. A number of studies have investigated the way face-to-face (Ruscher & Hammer, 2006) or computer mediated (Postmes, Spears & Lea, 2000) conversational interaction can produce group identity social norms, but these studies have not been able to analyze how these interactions unfold over time to produce emergent outcomes.

VIAPPL, the Virtual Interaction APPLication

VIAPPL is a platform that has been designed to run social experiments in a controlled virtual environment that allows researchers to observe what the participants collectively make of the conditions and manipulations they are subject to. The environment is designed to facilitate (1) experimental manipulation and (2) interaction between participants, while (3) observing how these interactions unfold over time, and (4) determining how collective action produces the evolving situation,

emergent social structures and individual and collective outcomes. These are the basic conditions that make possible an experimental social psychology of movement.

Participants are represented as avatars in the game-like VIAPPL environment. Figure 1 represents a two group-situation in which each participant can identify their avatar, but where the other participants are anonymous. The participants interact by exchanging tokens over a series of rounds which can be nested in one or more trials. Key variables can be manipulated across trials and experimental conditions. These presently include such factors as group belonging, the number and size of groups, the position of groups and individuals relative to each other in the virtual space, the starting balance of different groups or individuals, and the visual background against which interaction takes place (e.g., a dinner table, neighbourhood, prison, or summer camp). Other features of the environment such as group stereotypes, the stability and legitimacy of the situation, boundary permeability, and the intended meaning of the exchanges (e.g., valueless tokens, money, or a virus) can be manipulated via experimental instructions. Future developments of the software will allow virtually every feature of the environment to be manipulated, including making participants identifiable by using their own photograph as an avatar, allowing participants to move around the environment, communicate with each other using text messaging, interact with each other in real time rather than in rounds, or to change groups either by choice or automatically as they reach some performance threshold. Eventually we hope to allow group identity to emerge organically from the kinds of interactions individuals participate in. Additionally, VIAPPL is integrated with LimeSurvey, allowing researchers to administer questionnaires before and after the study and between trials.

Insert Figure 1 about here

The software environment allows participants to interact by exchanging tokens but the participants need to determine for themselves the rules and norms for selecting exchange partners. Tajfel (1972) argued that such determinations require a cultural analysis as participants solve the problem about how to act in experimental situations by "falling back" on "norms and values that [they] perceive as being pertinent to the situation" (p. 84). Thus, he initially argued that ingroup favouritism in the minimal group studies was the product of a cultural norm acquired in childhood. In addition to following salient cultural norms and values, however, the expectations about how to allocate tokens in a VIAPPL experiment are developed by observing the interactions and outcomes in the situation over time. The process is illustrated by Sherif's (1937) autokinetic illusion experiment in which participants made judgements about the distance a point of light appeared to move in an otherwise totally dark room. He found that individual judgements initially varied widely, but the verbal judgments of individuals within an experimental group tended to converge to an "emergent" norm that was peculiar to each group. Each participant's audible estimate of the light's movement was an instance of accountable conduct which was both shaped by an emerging norm that was apparent in the responses of others, and itself became part of the collective response thus helping to produce the norm.

VIAPPL provides a starting point and certain affordances for action. Participants find themselves in an experimental situation that provides the resources for meaning-making and action, but what they make of it and do with these is left up to them. The environment thus makes place for creativity on the part of the participants, who together are able to produce different interactions and outcomes in each replication of the experiment. This a dynamic situation in which the greatest resource participants have for acting appropriately is specified by what has happened previously.

VIAPPL reports individual and group balances and the exchanges that occurred after each round, thus representing for the participants the emerging situation and the kinds of exchanges that have produced the situation (see Figure 2). Expectations about how to act and treat others become sedimented in action, round by round, to produce emergent norms such as ingroup favoritism and fairness, and outcomes such as individual and group inequality. Even in the simple two-group scenario represented in Figures 1 and 2, researchers can use VIAPPL to study the dynamic process related to ingroup bias, ostracism, selfishness, radicalization, reciprocation, favouritism, inequality, majority and minority influence, and many others. Importantly, these 'outcomes' should not be viewed as the effects of the experimental situation or cultural norms on participants, but as the products of norm-sensitive social interaction in an experimental 'microcosm of society'.

Insert Figure 2 about here

Using VIAPPL to replicate the Minimal Group Studies

We have used VIAPPL to replicate the minimal group studies (Tajfel, 1970; Tajfel, Billig, Bundy & Flament, 1971) to determine how ingroup bias might evolve over time as an emergent property of social interaction. In the original studies, participants were assigned to groups on minimal criteria and were then required to make allocations to in- and outgroup members whom they had never met. Participants allocated rewards by selecting preferred options on reward matrices that represented strategies such as fairness, maximum difference, and maximum joint profit. Famously, they found that participants frequently selected maximum difference to ensure relative advantage even at cost to their group.

The experiments had all the hallmarks of the mechanistic designs decried by Haslam and Reicher (2007), which can show little else but how individual responses are shaped by situational forces. Although Tajfel (1972) originally explained the results in terms participants attempts to achieve "a compromise" between the norms of "groupness" and "fairness" and values of "solidarity" and "equity" that were "pertinent to the experimental situation" (p. 86), the design did not favor such an analysis. To the contrary, the once-off allocation of rewards following social categorization suggested that ingroup bias was a variety of 'nature's response', namely, the quest for self-esteem (see Condor, 2003). The design also exposed the study to criticism that "characteristics of the situation virtually demanded the observed ingroup-outgroup bias" (Gerard & Hoyt, 1974, p. 837).

We designed our initial set of VIAPPL experiments to examine how ingroup bias would emerge and play out over time in a situation where participants are not asked to make in- and outgroup allocations. We simply asked participants to give one token each round. We hypothesized that ingroup bias would be observable in the early rounds of exchange – either because of norms or due to the quest for positive distinctiveness – and this bias would be strengthened over time, under the influence of an emergent norm. In addition to a situation in which no norms were primed, following Hertel and Kerr (2001), we also primed norms of competition and fairness to determine whether we could influence the process of norm emergence. Finally, we manipulated equality and status by allocating the same number of starting tokens to groups under the equality conditions, but an unequal number of tokens to high and low status groups under the inequality conditions. Previous research indicates that high-status groups are more biased (cf. Bettencourt, Charlton, Dorr, & Hume, 2001; Otten, Mummendey, & Blanz, 1996). Our hypotheses were as follows:

H 1. Ingroup bias will be evident by greater ingroup-giving and less outgroup-giving in the group condition than in the individual condition.

H2. Ingroup bias will increase over time.

H 3. Ingroup bias will be stronger under conditions of competition than fairness.

H 4. High status groups will be more biased than low status groups.

Sample and Design

The study employed an experimental design with time as a repeated-measures factor, represented by the 40 rounds over which participants exchanged tokens, one token per round to any player in the arena. Although self-giving was possible, it was not advertised to participants and could only emerge if it was discovered by participants as the game progressed. Three between-subjects factors were operationalised as follows:

Individual versus Group condition: participants were randomly assigned to play either as undifferentiated individuals or as members of visually distinctive groups. Group categorization was random but participants believed they were assigned to a group based on their preference for a painting by Klee or Kandinsky. In the individual condition participants' avatars were allocated to groups, but participants were not aware of this allocation and there were no visual indicators of group membership. This provided a baseline in which any "ingroup bias" would be random.

Status Equality versus Inequality condition: participants were randomly assigned to conditions of equality or inequality. In the equality conditions, all players in the game arena started with equal numbers of tokens (30 per player). In the inequality condition initial token balances differed across groups (in the group condition) or between individuals (in the individual condition). High status groups or individuals began the game with 40 tokens per player while low status groups or individuals were initially allocated 20 tokens each.

Norm activation: participants completed an adaptation of the verbal memory task developed by Hertel and Fiedler (1994; Hertel & Kerr, 2001) which primed either no norm, fairness or competition. Neutral words, such as computer, car and tree, were used throughout the three primes. Only neutral words were used in the control (no norm) condition. Competition was evoked through words such as opponent, hostility, struggle; while the fairness prime included words such as balance, justice, and democratic.

When crossed, these factors resulted in a 12 cell design, where each of the 12 cells represented a VIAPPL game to be played by 14 participants under a specific set of conditions, with each cell replicated six times in the overall study. This resulted in a total of 72 VIAPPL games in the study with 1004 participants, who were undergraduate student volunteers from the University of KwaZulu-Natal, South Africa.

The dependent variables were derived from the number of tokens each individual allocated to members of the ingroup, members of the outgroup, or to themselves.

Results

Three Generalized Linear Mixed Models (GLMM) with binary logistic regression were run using SPSS with independent variables group categorization, status inequality, and norms on (1) ingroup-giving, (2) self-giving and (3) outgroup-giving. Bonferroni's correction was used to limit familywise error across the three GLMM models, thus alpha was set at 0.017 (0.05/3) to assess overall model significance. All three models were significant at this level – ingroup bias ($F(10, 40143) = 7.536$, $p=0.000$), self-giving ($F(10, 40143)=11.381$, $p=0.000$), and outgroup-giving ($F(10, 40143)=11.940$, $p=0.000$). For economy the models for the three dependent measures – ingroup-giving, self-giving and outgroup-giving – will be reported concurrently.

There was a significant difference in ingroup-giving ($\beta= -0.765$, $SE=0.150$, $p= 0.000$) and outgroup-giving ($\beta= 0.779$, $SE=0.160$, $p= 0.000$) between the individual and group condition, indicating that the group manipulation was successful and group membership played an important role in the allocation of tokens (see Figure 3). As predicted, ingroup-giving was higher ($M: 0.530 > 0.397$) and outgroup-giving was lower ($M: 0.359 < 0.503$) in the group condition than individual condition. This supports the findings of the Minimal Group Studies (and hypothesis 1), which concluded that categorization into meaningless groups can result in bias toward the ingroup. In contrast, there was no significant difference in self-giving between the group and individual conditions ($F(1, 40.143)=2.742$, $p=0.098$).

Insert Figure 3 about here

An analysis of interactions showed that self-giving increased significantly more over time in the individual condition compared to the group condition ($F(1,40.143) = 3.952$, $p=0.047$; $\beta= 0.013$, $SE=0.007$, $p=0.047$), suggesting that it became a stronger emergent norm when group membership could not be

drawn on to provide information to guide social behavior. On the other hand, ingroup-giving increased significantly more over time in the group compared to the individual condition – as indicated by the significant interaction effect between group categorization and time (round) (β= 0.008, SE=0.003, p= 0.004) – while outgroup-giving decreased significantly more over time in the group condition (β= -0.007, SE=0.003, p= 0.002). Together, these results support hypothesis 2, which states that that ingroup bias will increase over time. The increase in ingroup-giving and decrease in outgroup-giving, should be interpreted in the light of increased self-giving over time because the three forms of giving are mutually constrained.[i] The results showed that participants in the group condition were willing to sacrifice outgroup-giving but not ingroup-giving as self-giving emerged as a norm as the game progressed. After self-giving is discovered it tends to replace both ingroup and outgroup-giving in the individual condition. In contrast, self-giving tends to displace outgroup-giving but not ingroup-giving in the group condition.

The Status-inequality and norm manipulations had no significant main effect on ingroup-giving or outgroup-giving. However, there were significant three-way interactions among the three experimental factors – group, status and norms – for both ingroup-giving (F(2, 40.143)=3.475, p=0.031) and self-giving (F(2, 40.143)=3.738, p=0.024) but not outgroup-giving (F(2, 40.143)=1.070, p=0.3.4). The means are represented in figures 4, 5 and 6. Figure 4 shows that only when fairness is primed, ingroup-giving is not significantly different in the individual and group condition under conditions of inequality. Therefore participants appear to be acting more like individuals than group members in the inequality condition by not showing significantly higher levels of ingroup bias than by random chance. Ingroup-giving was especially strong in the group inequality condition when no norms were primed compared to both the fairness and competition conditions (F(2, 40.143)=10.646, p=0.000). Figure 5 shows that self-giving is not significantly different between the individual and group condition under any of the norm manipulations. The significant three-way interaction reflects difference in self-giving in the competition and no-norm

conditions under group inequality. Priming competition promoted self-giving in unequal group situations, whereas self-giving was less likely to occur in unequal group situations when no norm was primed ($F(2, 40.143)=6.352$, $p=0.002$). The means in Figure 6 mirror those in Figure 4. The fairness manipulation reduced differences in outgroup-giving between the individual and group conditions. The reduced outgroup-giving in the no-norm inequality group condition reflected the increased ingroup-giving in this condition reported in Figure 5.

Overall, the higher order interactions show that, as hypothesized, the fairness prime tends to reduce ingroup bias, leading participants in the group condition to behave like those in the individual condition. The interactions also showed that the inequality condition powerfully affected behavior in the group condition, promoting self-giving under conditions of competition and ingroup-giving when no norms were primed. The higher levels of self-giving may be attributed to the fact that priming competition promote interpersonal, rather than intergroup competition, whereas under the no norm condition, inequality promotes ingroup bias. The following analysis will investigate how high status and lows status groups performed under the inequality condition.

Insert Figure 4 about here

Insert Figure 5 about here

Insert Figure 6 about here

Additional GLMMs were run to explore differences in ingroup-giving, self-giving and outgroup-giving between the low status and high status groups in the inequality condition. The results indicated a significant difference in ingroup-giving (β= 0.937, SE=0.191, p= 0.000) and outgroup-giving (β= -1.031, SE=0.204, p= 0.000) between the low and high status groups. The pairwise contrasts showed that the low status group acted with greater ingroup-giving (β= 0.182, SE=0.020, p= 0.000; M: 0.555 > 0.373) and less outgroup-giving (β=- 0.178, SE=0.022, p= 0.000; M: 0.339<0.518) compared to the high status group. The models also showed interactions between: time and ingroup-giving (β= -0.016, SE=0.004, p= 0.000) where ingroup-giving decreased over time in the low compared to the high status group; and time and outgroup-giving (β= 0.018, SE=0.004, p= 0.000), where outgroup-giving increased more over time for the low status group. Taken together, these results suggest that although ingroup-giving was higher overall for the low status group, this decreased over time through interaction. In terms of self-giving, however, there was no significant difference between the low and high status groups (β= 0.310, SE=0.445, p= 0.487), and no significant interaction between time and self-giving (β= -0.010, SE=0.010, p= 0.335). These results do not support hypothesis 4 and the body of literature that has shown that high status groups tend to show more ingroup bias than low status groups. In contrast, our results suggest that advantaged group members tend to give to disadvantaged group members and disadvantaged group members tend to give themselves to undo the inequality, but up to a certain point, after which advantaged group members tend to replace outgroup-giving with ingroup-giving.

Network Analysis

A unique strength of VIAPPL is its ability to represent behavior in each round as a directional social network, allowing us to analyze collective behavior as patterns of dynamic social connections. This was especially important in the light of the massive round-by-round fluctuation in ingroup-giving that was

evident in each of the experiments and in the graphs in Figure 3. Where the statistics above treat the individual as the unit of analysis and identify trends by aggregating individual responses across conditions, network statistics identify trends in patterns of ties, allowing emergent network states both to be predicted and to serve as explanations for other outcomes.

The package RELEVENT for R (Butts, 2013) was used to model the event-type longitudinal social network data to identify patterns of token exchanges embedded in networks that would not be picked up by the generalized linear mixed model. This package was the best suited for the current data because it was designed for the analysis of event-type data, which describe ties that change rapidly – e.g., communication patterns (see Butts, 2008) – as opposed to state ties which are maintained for longer periods of time (e.g., friendship).

The network analysis was conducted on the data from the group condition only; which was made up of a total of 36 individual games over 40 rounds, with six experiments per cell of the 2 (equality/inequality) x 3 (No Norm/Competition Norm/Fairness norm) factorial design. A single model was developed using the available parameters in the package that best matched the research questions and hypotheses. These parameters were: the rich-get-richer effect (NIDRec+/-); persistence of relationships over time (FrPSndSnd); delayed reciprocity (RRecSnd); resending recent ties (RSndSnd); direct ingroup-giving (CovEvent); and immediate reciprocity (PSAB-BA). These parameters are described and discussed in more detail below.

This model was run on all the games and summarized using meta-analytic techniques. The combined results can be found in Table 1, which shows for each cell: in how many games each parameter was significant; the number of times parameters were significantly positive or negative in each cell; and the

outcome of Fisher's combined probability assessing overall levels of significance across the six games in each condition. This was interpreted non-directionally since we expected the direction of some parameters to reverse in relation to some experimental manipulations.

Insert Table 1 about here

Most of the parameters were significant in most of the games across conditions (Table 1). Fisher's combined probabilities indicated that all of the parameters usefully modelled network outcomes in some conditions, and most parameters usefully modelled behavior in at least one game in every condition. The exceptions were for rich-get-richer effect (NIDRec), which was not a useful predictor of behavior in the inequality/fairness condition, and immediate reciprocity effect (PSAB-BA), which, according to Fisher's test, only reliably modelled behavior in one game each in the equality/no-norm and equality/fairness conditions. However, despite the usefulness of most of the parameters most of the time, there was substantial variation within and across conditions in the significance of parameters and, when significant, their direction.

Rich-get-richer (NIDRec+/-): In the VIAPPL environment, preferential attachment to the rich occurs when players give tokens to players with high indegree/token balances rather than players with low indegree/token balance. A positive parameter indicates that players with high indegree/token balance are more likely to receive tokens; while a negative parameter indicates that the wealthy are ostracized. Negative NIDRec effects can therefore be interpreted as a form of fairness. It was only in the inequality/fairness condition that the rich-get-richer effect did not significantly model interactions in any of the six games, but there was substantial heterogeneity in how and how much preferential attachment to the rich emerged. In the inequality/no-norm and equality/fairness conditions the consistently

negative parameter indicated fairness. In the other conditions, the parameter was often significant, but with heterogeneity in whether it was positive (preferential attachment to rich) or negative (fairness). Overall, there was a greater tendency toward fairness than preferential attachment, with only four games (two in the Inequality Competition condition) showing a significant rich-get-richer preferential attachment effect.

Persistence (FrPSndSnd+): This parameter represents persistence in ties over time; a form of social inertia (Butts, 2008). In the VIAPPL environment this parameter indicates that players are more likely to allocate tokens to those with whom they have an established history of token allocation. Persistence was a common significant trend across all conditions, although less so in the equality/no-norm condition, with this parameter being significant in only half the games in this condition. The direction of the persistence parameter was consistently positive, indicating that participants were more likely to give tokens to players to whom they had given to in the past, except for one game in the equality/competition condition where the parameter was negative, indicating that players were less likely to give tokens to players they had given to in the past. Therefore, the overall trend across conditions was to develop relationships with other players in the network over time.

Re-sending recent ties (RSndSnd+/-): The re-sending recent ties parameter, if positive, indicates that the persistence effect occurs soon after ties are first established. A negative effect indicates that if ties are resent, they are resent only much later in the interaction. The combination of positive (n=6) and negative results (n=10) across the conditions suggests that first, this is possibly a less important strategy for token allocation and second, that players tend to maintain their relationship by resending, and even where this not always possible to do immediately, players remember past acts of giving and repeat these in later rounds suggesting that there is some sort of 'queuing system' when it comes to the

maintenance of relationships as participants attempt to manage their social environment within the limitations of the environment, such as the rule that only one token could be given each round.

Immediate reciprocity (PSAB-BA+): This parameter refers to reciprocity strictly structured by turn-taking, where reciprocation occurs in the round directly following the receipt of a token. Overall, this was not a strong trend in any of the conditions with only one game in each of four conditions showing significance. In three of these the parameter was positive, showing an increased probability of players immediately reciprocating ties in these isolated games. In one game (in the equality/fairness condition) the significant negative parameter indicated a tendency to *avoid* reciprocating in the round following the receipt of a token from another player.

Delayed reciprocity (RRecSnd+): Formally this effect refers to the extent to which the recency of receiving a tie from another player impacts on the future rate of returning that tie. In this VIAPPL study, it can be viewed as an indicator of delayed reciprocity in which players are more likely to give tokens to others who have given to them recently, but not necessarily in the rounds directly following receipt. This parameter was significant in more than half of the games across conditions, but less commonly significant in the equality/no-norm (3/6), inequality/competition (3/6) and inequality/fairness (2/6) conditions. Delayed reciprocity can therefore be considered a reasonably strong norm across conditions, but one which sometimes fails to emerge.

Ingroup bias (CovEvent+): This is a custom parameter calculated against categorical group membership as a covariate. A positive effect indicates the presence of ingroup bias, in other words, that players are more likely to allocate tokens to others in their own group, while a negative parameter indicates outgroup bias. This parameter was consistently significant and positive across all the conditions,

indicating that ingroup bias persisted even when fairness was primed or when conditions of inequality existed. However, there were two games in which the direction of the parameter was significant and reversed, indicating that participants were more likely to give to members of the outgroup: one was in the inequality/no-norm condition; the other was in the inequality/fairness condition.

Discussion and conclusions

We replicated the minimal group studies using a newly developed experimental platform – VIAPPL – that facilitates two-way channels of social influence of norms and identities on individual behaviors and of the collective patterning of individual behaviors on norms and identities. VIAPPL thus allows us to observe ingroup bias as an emergent phenomenon that evolved in interaction over time.

Our results support the body of research that shows that social categorization is a sufficient condition for the display of ingroup bias (Diehl, 1990). In addition, our data strengthen this body of literature in a number of respects. First, our operationalization of ingroup bias is particularly robust in contrast to studies that use allocation matrices to assess bias as a once-off allocation of resources to in- and out-group members in response to experimenter instructions. The instruction to play the game by allocating one token per round to any other player hardly demands ingroup favoritism (cf. Gerard & Hoyt, 1974). Second, our studies show that ingroup bias is apparent even in situations where self-allocations can be made. In contrast, the original studies did not allow self-allocations and could thus not determine whether ingroup bias would be apparent over and above self-interest. We did not inform our participants that they could self-allocate, but they invariably discovered it sooner or later, and once discovered, self-giving generally increased over time, becoming an emergent norm.

Our GLMM analysis and Figure 3 show that ingroup-giving was not affected by the increasing tendency for self-giving over time, suggesting that ingroup bias can be expected to occur alongside self-interest. Our results thus provide support for our hypothesis that ingroup bias would increase over time. In the later rounds of the experiments, outgroup-giving decreased and ingroup-giving increased (relative to the decrease in ingroup giving that resulted from increased self-giving). The interactions reported in figures 4, 5 and 6 show that ingroup bias can be reduced by priming fairness, but that ingroup bias is especially strong in the inequality condition when no norms were primed. In contrast, when competition was primed, the participants tended to respond by self-giving in the inequality condition. The overall pattern of results suggest that, in contrast to the individual condition, group identity generally promotes ingroup bias, but this effect is moderated by norms of competition and fairness, and by inequality. Inequality, especially promoted ingroup bias among the low status group. However, under conditions of competition and inequality, group identity promoted the individual strategy of self-giving rather than ingroup bias. These results show that neither norms nor structural features of the social environment had monolithic effects on social actions such as ingroup giving or self-giving; instead participants interpreted these social conditions relationally, with each feature providing context for the others.

In addition to supporting, strengthening and qualifying the conclusions of minimal group research, VIAPPL generated some unique insights into the psychological properties of the minimal group situation. Most centrally, it showed that behavior in the minimal group situation is shaped by emergent norms and structural features of the intergroup situation, such as inequality. Although Tajfel (1972) had originally described ingroup bias as a cultural norm, and research has shown that it is affected by imposed norms (Hertel & Kerr, 2001), VIAPPL allowed us to show how some behaviors strengthened over time whereas others weakened. In particular, once self-giving was discovered, it strengthened over time. In the group condition, self-giving displaced outgroup-giving but not ingroup-giving. Behavioral norms were also

staged by the situation within which interaction occurred. The various experimental manipulations created distinct situations which strengthened one or other response, for example, decreasing ingroup bias under conditions of primed fairness or increasing self-giving under unequal competitive conditions. In contrast to previous research (Bettencourt et al., 2001), we found that low status groups members demonstrated more ingroup bias than members of high status groups, but this effect decreased over time. Presumably, it was deemed acceptable for both groups to give tokens to the low status group that had fewer tokens at the start, but norms changed as things began to equalize, and the high status group replaced outgroup- with ingroup-giving. The normative situation was thus created both by manipulations of the experimenter and by the situation that participants constructed through their ongoing interactions.

One of the major strengths of the VIAPPL platform is that it allows us to represent interaction as ties between nodes. This allows us to capitalize on recent developments in network methods to represent social interaction as dynamic social networks. We have only begun to exploit the potential of this branch of network science that is still in development (see Ripley, Boitmanis, & Snijders, 2014; Butts, 2008). Even so, the longitudinal event-based network analysis identified important patterns of interaction that were invisible to the Generalized Linear Mixed Model. Most generally, the results show that although the experimenter-constructed situations provided affordances for action, they did not determine outcomes. Participants had the power shape the situation that they participated in by adopting situation specific behaviors and producing these as norms. For example, network analysis confirmed that ingroup bias is powerful and persists even in the face of fairness and inequality manipulations, but there were a number of games in which ingroup bias failed to occur, and there were two games (in the inequality condition) in which the ingroup bias norm was significantly reversed, resulting in a norm of outgroup-giving. All the other effects reported in Table 1 showed similar variation, and even reversal, both across

and within experimental situations. Our data thus suggest that there is no single minimal group situation that is constructed solely by the experimenter, and that has a uniform effect on behavior. Certainly, experiments can promote or weaken behaviors such as ingroup bias creating intergroup contexts and priming competition, but which behaviors eventually emerge as norms depends on what the participants do with what they are given.

Network analysis also suggested that participants managed contending demand on their actions. The results reported in Table 1 show that ingroup bias is counterbalanced by a tendency towards fairness, where participants often avoided assigning tokens to those who were already rich (i.e., where preferential attachment/fairness was negative); and where players reciprocated and strengthened social connections by re-giving. The overall pattern of results suggests that ingroup bias is a practice that operates alongside other practices, including reciprocation, fairness, and self-giving. Each of these behaviors can end up becoming dominant in a single experiment, and different combinations of these behaviors become dominant from round to round, depending on the nature of the situation that each round presents to the participants. The network analysis showed that participants assigning tokens in a way that was cognizant of token balances, who had already given to them, and to whom they had already given (indicated by persistence, immediate reciprocity, delayed reciprocity, and resending recent ties). Players most often preferred delayed to immediate reciprocity and re-giving. Because participants could only give one allocation per round they were exposed to complex choices deciding between contending imperatives to give to the poor, to return favors, to seek favor with the rich, and to build friendship and ingroup communities. These multiple demands likely resulted in delayed reciprocation and re-giving as players selected some actions over others, but nonetheless remained aware of expectations that had been set up by previous interactions. Delayed reciprocation and re-giving showed that players were historically tracking their engagement with social partners and

maintaining ties across rounds. Therefore, even in this minimal group environment, the evidence suggests that actors were paying careful attention to building and maintaining relationships, and that these emergent relationships were sensitive to – but not fully determined by – externally imposed features of the social context, such as group membership, status equality/inequality or imposed behavioral norms (e.g., competition/fairness).

The evidence of memory, obligation, and choice combined with the observation of dynamic situational change suggests that VIAPPL allows us to study the minimal group situation in terms of a science of movement. Like the participants in Milgram's study, the participants needed to make choices about which imperative for action they would follow. Of course, this is true also of the participants who selected response options on the original allocation matrices. However, VIAPPL renders visible the process by which these individual choices and actions form part of collective action from which norms and identities emerge in an open-ended way that has the potential to lead the interaction along paths that produce novel and even unexpected outcomes.

Further research is required to explore how such local norms emerge within a specific social micro-context. Nonetheless, our findings are particularly optimistic, since they suggests that constructs such as ingroup bias and self-interest are emergent properties of dynamic social networks as much as they are outcomes of individual psychological mechanisms, and that changes to interaction networks might result in dramatically different collective outcomes. This opens up new avenues for future research that seeks identify conditions and processes that would produce desired outcomes, such as building outgroup trust, reducing radicalization, or promoting equality or social inclusion.

Our first set of experiments with VIAPPL suggests that the platform is a useful tool for social psychology research. We have replicated the results of the minimal group studies, examining the effects of social categorization in a genuinely social environment that is constantly being rebuilt by interaction and that is regulated by norms that emerge from the interaction. Like the classic experiments of the past, this *environment* allows us to: (a) operationalize dependent variables such as "ingroup bias" as social action within a social system rather than as self-report analogues of such action, (b) manipulate and control key variables, and (c) observe the evolution of social behavior and phenomena in interaction, comparing emergent dynamics and outcomes across conditions, which are treated as affordances for, rather than determinants of, action.

Of course, our research and the VIAPPL platform are still in an early stage of development. In this first round of minimal group experiments, the tokens were valueless, and participants received a standard $2 incentive irrespective of their final balance. In the spirit of the minimal group paradigm, it is remarkable that in participants would express ingroup bias and self-interest in such a situation, but it is possible that outgroup bias and self-interest are likely to play out differently in replications where the tokens have a monetary value. Our analysis was also limited by the available tools for the analysis of dynamic event networks. RELEVANT does not yet make available procedures for analyzing interactions between parameters, so we were not able to determine, for example, whether reciprocity emerges more commonly with members of the ingroup or outgroup. Finally, future developments of VIAPPL will integrate psychometric and biometric measures, thus providing an end-to-end view of the reciprocal chains of psychological processes, agency and collective network outcomes that constitute social life. We hope that such a tool will contribute to the development of social psychology as a 'science of movement'.

References

Asch, S.E. (1951). Effects of group pressure on the modification and distortion of judgments. In H. Guetzkow (Ed.), *Groups, leadership and men* (pp. 177–190). Pittsburgh, PA: Carnegie Press.

Bettencourt, B., Dorr, & Hume, D. (2001). Status differences and in-group bias: A meta-analytic examination of the effects of status stability, status legitimacy, and group permeability. *Psychological Bulletin, 127*(4), 520-542.

Billig, M. (1976). *Social psychology and intergroup relations*. London, United Kingdom: Academic Press.

Burger, J. (2009). Replicating Milgram: Would people still obey today? *American Psychologist*, *64*, 1–11. doi:10.1037/a0010932.

Butts, C. T. (2008). A relational event framework for social action. *Sociological Methodology*, *38*(1), 155-200.

Butts, C. T. (2013). relevent: Relational Event Models. R package version 1.0-3. http://CRAN.R-project.org/package=relevent

Condor, S. (2003). 'The least doubtful promise for the future'? The short history of Tajfel's 'sociopsychological' approach to laboratory experimentations. In J. Lazlo & W. Wagner (eds). *Theories and controversies in social psychology* (pp.). Budapest: New Mandate.

Diehl, M. (1990). The Minimal Group Paradigm: Theoretical Explanations and Empirical Findings. *European Review of Social Psychology, 1*(1), 263-292. (Doi: 10.1080/14792779108401864.)

Drury, J., & Reicher, S. (2000). Collective action and psychological change: The emergence of new social identities. *British Journal of Social Psychology*, *39*, 579-604.

Drury, J., & Reicher, S. (2009). Collective psychological empowerment as a model of social change: Researching crowds and power. *Journal of Social Issues*, *65*(4), 707-725.

Drury, J., Reicher, S., & Stott, C. (2003). Transforming the boundaries of collective identity: From the "local" anti-road campaign to "global" resistance? *Social Movement Studies*, *2*, 191-212.

Gerard, H. B., & Hoyt, M. F. (1974). Distinctiveness of social categorization and attitude toward ingroup members. *Journal of Personality and Social Psychology*, *29*(6), 836-842.

Haney, C., Banks, C. & Zimbardo, P. (1973). Interpersonal Dynamics in a Simulated Prison. *International Journal of Criminology and Penology, 1*, 69-97.

Haslam, S. A. & Reicher, S. (2006). Debating the psychology of tyranny: Fundamental issues of theory, perspective and science. *British Journal of Social Psychology, 45*(1), 55-63. DOI:10.1348/014466605X80686.

Haslam, S. A., & Reicher, S. (2007). Identity entrepreneurship and the consequences of identity failure: The dynamics of leadership in the BBC prison study. *Social Psychology Quarterly*, *70*(2), 125–147.

Haslam, S. A., & Reicher, S. D. (2012). Contesting the 'nature' of conformity: What Milgram and Zimbardo's studies really show. *PLoS Biology*, *10*(11), e1001426. doi:10.1371/journal.pbio.1001426.

Hertel, G., & Fiedler, K. (1994). Affective and cognitive influences in a social dilemma game. European Journal of Social Psychology, 24, 131–145.

Hertel, G. & Kerr, N. L. (2001).Priming in-group favoritism: The impact of normative scripts in the minimal group paradigm.*Journal of Experimental Social Psychology*, **37**, 316-324.
DOI: 10.1006/jesp.2000.1447

Klein, O., Spears, R., Reicher, S. (2007). Social identity performance: Extending the strategic side of SIDE. *Personality and Social Psychology Review*, *11*, 28-45.

Milgram, S. (1963). Behavioral study of obedience. *Journal of Abnormal and Social Psychology*, *67*, 371–378. doi:10.1037/h0040525.

Milgram, S. (1974). *Obedience to authority*. New York: Harper & Row.

Orne, M. T. (1962). On the social psychology of the psychological experiment: With particular reference to demand characteristics and their implications. *American Psychologist*, *17*(11), 776-783. doi: 10.1037/h0043424

Otten, S., Mummendey, A. & Blanz, M. (1996). Intergroup Discrimination in Positive and Negative Outcome Allocations: Impact of Stimulus Valence, Relative Group Status, and Relative Group Size. *Personality and Social Psychology Bulletin, 22*(6), 568-581.

Postmes, T., Haslam, S. A., & Swaab, R. I. (2005). Social influence in small groups: An interactive model of social identity formation. *European Review of Social Psychology*, *16*, 1–42.

Postmes, T., Spears, R., & Lea, M. (2000). The formation of group norms in computer-mediated communication. *Human Communication Research*, *26*, 341–371.

R Development Core Team. (2014). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. ISBN 3-900051-07-0. Available:http://www.R-project.org.

Ratnesar, R. (2011, July/August). The Menace Within. *Stanford Magazine*. Retrieved from https://alumni.stanford.edu/get/page/magazine/article/?article_id=40741.

Reicher, S. (1984). Social influence in the crowd: Attitudinal and behavioural effects of de-individuation in conditions of high and low group salience. *British Journal of Social Psychology*, *23*(4), 341-350.

Reicher, S. (1996). "The Battle of Westminster": Developing the social identity model of crowd behaviour in order to explain the initiation and development of collective conflict. *European Journal of Social Psychology*, *26*, 115 – 134.

Reicher, S., & Haslam, A. (2013). Towards a 'science of movement': Identity, authority and influence in the production of social stability and social change. *Journal of Social and Political Psychology*, *1*(1), 112–131, doi:10.5964/jspp.v1i1.266

Reicher, S. D., Haslam, S.A., & Smith, J. R. (2012).Working towards the experimenter: Reconceptualizing obedience within the Milgram paradigm as identification based followership. *Perspectives on Psychological Science*, *7*, 315–324. doi: 10.1177/1745691612448482.

Reicher, S.D., Spears, R., & Postmes, T. (1995). A social identity model of deindividuation phenomena. *European Review of Social Psychology*, *6*, 161-198.

Ripley, R., Boitmanis, K., & Snijders, T. A. (2014). RSiena – Simulation Investigation for Empirical Network Analysis. R package version 1.1.276.

Rosenthal, R. (1963). On the social psychology of the psychological experiment: 1, 2 The experimenter's hypothesis as unintended determinant of experimental results. *American Scientist, 51*(2), 268-283.

Rosenthal, R., & Rubin, D. B. (1978). Interpersonal expectancy effects: The first 345 studies. *The Behavioral and Brain Sciences*, *1*, 377–415.

Ross, L., & Nisbett, R. E. (1991). *The person and the situation: Perspectives of social psychology. New York: McGraw-Hill*

Ruscher, J. B. & Hammer, E. D. (2006). The development of shared stereotypic impressions in conversation: An emerging model, methods, and extensions to cross-group settings. *Journal of Language and Social Psychology*, *25*, 221-243.

Sherif, M. (1937). An experimental approach to the study of attitudes. *Sociometry*, *1*(1/2), 90-98.

Sherif, M. (1958). Superordinate Goals in the Reduction of Intergroup Conflict. *American Journal of Sociology, 63*, 349-356.

Spears, R., & Postmes, T. (2014). Group identity, social influence and collective action online: Extensions and applications of the SIDE Model. In S.S. Sundar (ed.) *The Handbook of Psychology of Communication Technology*. Oxford: Blackwell.

Tajfel, H. (1970). Experiments in intergroup discrimination. *Scientific American*, *223*(2), 96-102.

Tajfel, H., Billig, M. G., Bundy, R. P., & Flament, C. (1971). Social categorization and intergroup behavior. *European Journal of Social Psychology*, *1*(2), 149-178.

Tajfel, H. (1972). Experiments in a vacuum. In Israel, J. & Tajfel, H. (Eds.) The context of social psychology: A critical assessment (pp. 69-119). London: Academic Press.

Zimbardo, P. G., Maslach, C. & Haney, C. (2000). Obedience to Authority: Current Perspectives on the Milgram Paradigm. In T. Blass (ed.), (pp. 193-238). Psychology Press.

Figure 1. Illustration of a VIAPPL environment, where avatars are circles, the current participant is bold, and each player's token balance is indicated alongside the avatar

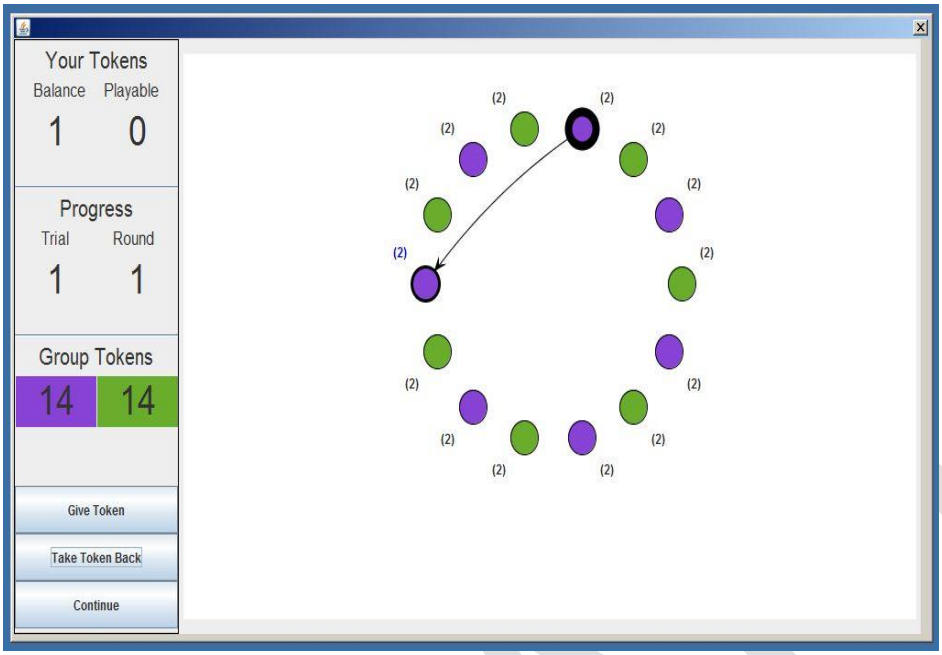
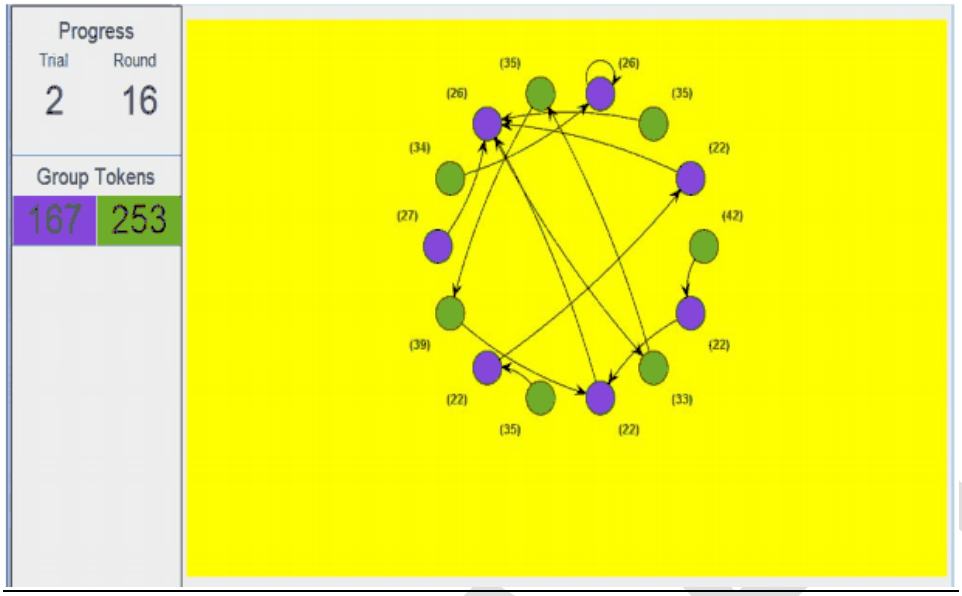


Figure 2. Round summary



Note. Self-giving is represented by a circular tie from and to the same player.

Figure 3. Mean ingroup-giving, outgroup-giving and self-giving over 40 rounds

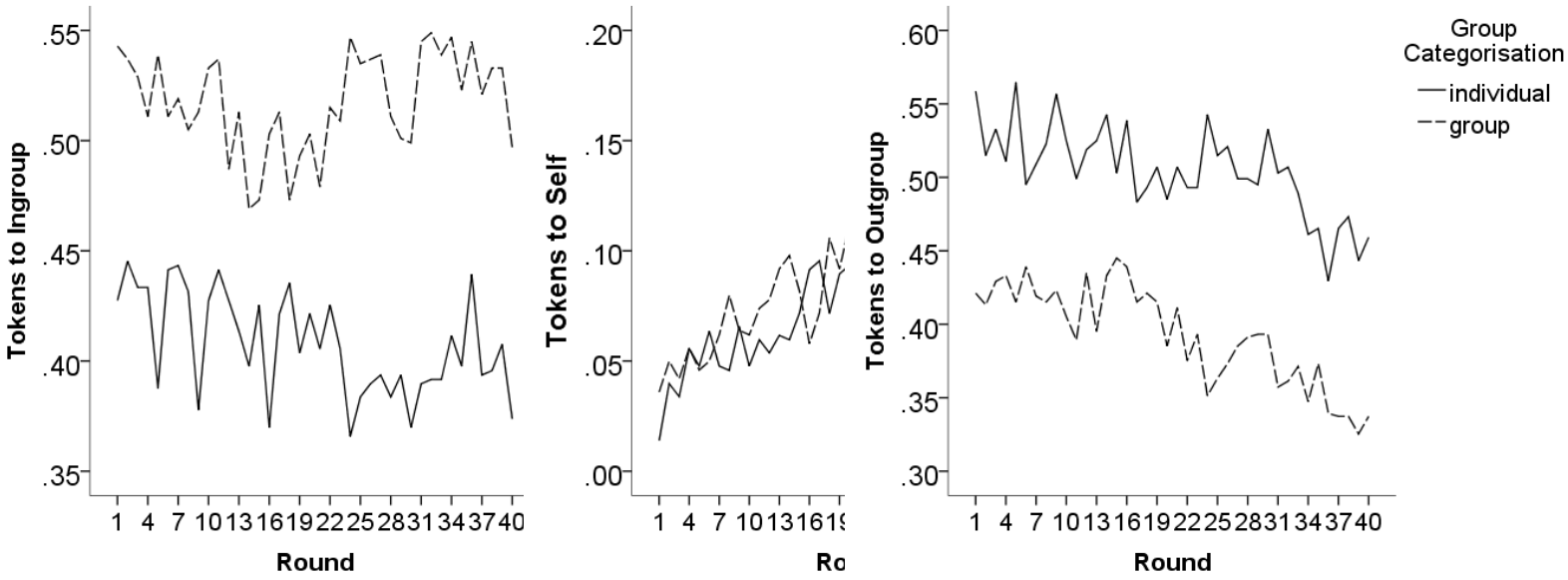


Figure 4. Ingroup bias by group categorization, fairness and inequality

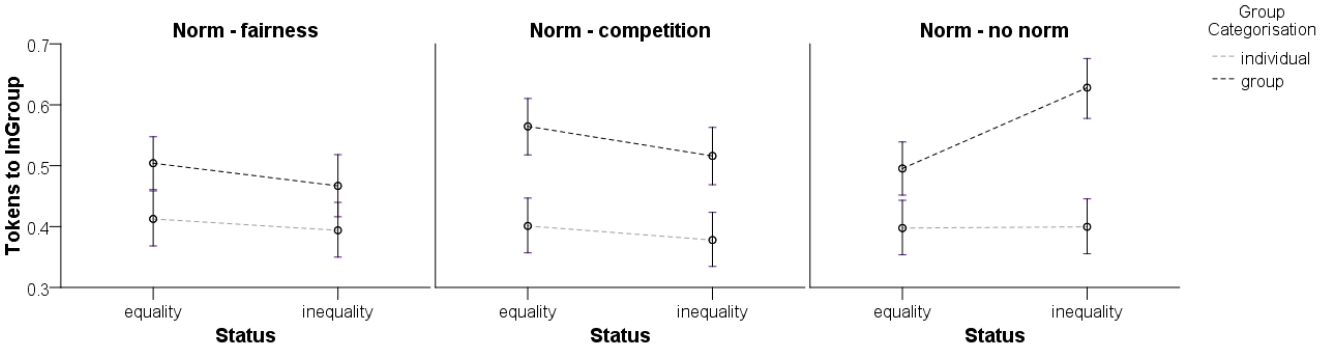


Figure 5. Self-giving by group categorization, fairness and inequality

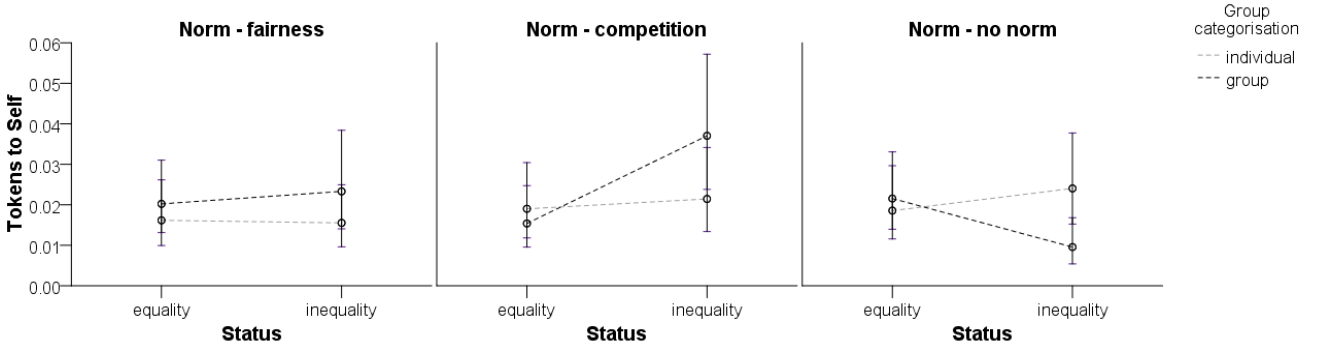


Figure 6. Outgroup-giving by group categorization, fairness and inequality

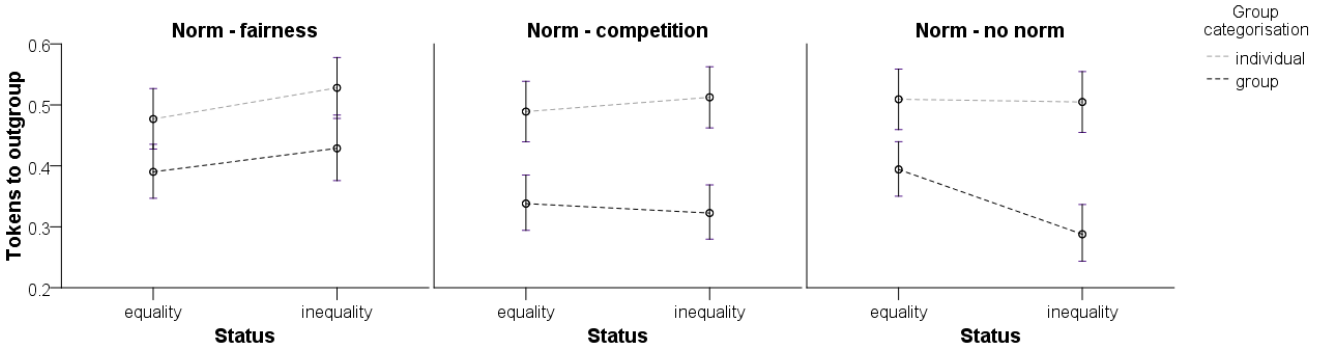


Table 1. Results of the Network Analysis

	Game condition					
	Equality			Inequality		
	No Norm	Competition	Fairness	No Norm	Competition	Fairness
Rich-get-richer (NIDRec)	**3** (1+,2-)‡	**4 (**1+, 3-)‡	**5 (**0+, 5-)‡	**3 (**0+, 3-)‡	**5 (**2+, 3-)‡	**0**
Persistence (FrPSndSnd)	**3** (3+,0-)‡	**5 (**4+,1-)‡	**5 (**5+,0-)‡	**5 (**5+,0-)‡	**5 (**5+,0-)‡	**4 (**4+,0-)‡
Resending recent ties (RSndSnd)	**4** (1+,3-)‡	**5 (**2+,3-)‡	**3 (**3+,0-)‡	**2 (**1+,1-)‡	**2 (**0+,2-)‡	**1 (**0+,1-)‡
Immediate reciprocity (PSAB-BA)	**1** (1+,0-)‡	**0**	**1 (**0+,1-)†	**1 (**1+,0-)	**1 (**1+,0-)	**0**
Delayed reciprocity (RRecSnd)	**3** (3+,0-)‡	**4 (**4+,0-)‡	**4 (**4+,0-)‡	**4 (**4+,0-)‡	**3 (**3+,0-)‡	**2 (**2+,0-)‡
Ingroup bias (CovEvent)	**6** (6+,0-)‡	**5 (**5+,0-)‡	**5 (**5+,0-)‡	**6 (**5+,1-)‡	**5 (**5+,0-)‡	**5 (**4+,1-)‡

Notes. The emboldened numbers indicate the number of games (out of 6) in which the parameter was significant. Figures in brackets show, for significant parameters, how many were positive and how many were negative. Significance for Fisher's combined probability per condition: *p<0.1; †p<0.05; ‡ p<0.01 (d.f. = 12); cells in which Fisher's combined probability was not significant are shaded.

END NOTES

[i] Participants allocate one token each round, either giving it to an ingroup member, an outgroup member or to themselves. Ingroup-giving, outgroup-giving and self-giving are mutually exclusive and exhaustive responses. Each choice necessarily excludes the other two, and so an overall increase in the popularity of one choice will decrease the likelihood of occurrence of the other two choices.