Economics
Working Papers

2023-11

Ambiguity induces opportunistic rule breaking and erodes social norms

Lucas Molleman, Daniele Nosenzo and Tina Venema

AARHUS BSS
DEPARTMENT OF ECONOMICS
AND BUSINESS ECONOMICS
AARHUS UNIVERSITY

Title

Ambiguity induces opportunistic rule breaking and erodes social norms

Authors

Lucas Molleman*[1,2], Daniele Nosenzo[3], Tina Venema[4]

[1] Department of Psychology, University of Amsterdam, The Netherlands
[2] Social Psychology, Tilburg University, The Netherlands
[3] Department of Economics and Business Economics, Aarhus University, Denmark
[4] Copernicus Institute of Sustainable Development, Utrecht University, The Netherlands
***** Corresponding author

Abstract

Rules are central to social order, but violations can rapidly spread when compliance is costly to individuals. Moreover, rules are often ambiguous and open to interpretation, creating “wiggle room" to bend rules in self-serving ways. It is currently unknown how ambiguity shapes rule compliance and the sway of social influence. Here we present incentivized experiments (total n=3,226 American Prolific workers) showing that ambiguity substantially reduces rule compliance. Observing rule bending or a rule violation reduces compliance, but observing compliance does not increase it. The combined effect of ambiguity and bad examples is as strong as the effect of either factor on its own, indicating that many people comply unless an opportunity arises for self-serving rule violation. Further experiments suggest that these results are due to weakened social norms: ambiguity reduces disapproval of rule bending, and people expect violations to increase after observing non-compliance.

Keywords: Rule-following; peer effects; conditional compliance; behavioral experiment; social influence

Statement of Relevance

Outbreaks of rule violations are a critical threat to social order, but the individual-level processes underlying them are poorly understood. We used incentivized experiments to examine how compliance with individually costly rules is affected by ambiguity (creating “wiggle room” for self-serving interpretations of the rule) and by observing others’ behavior (where bad examples of rule violation may provide an excuse for violating too). Results show that rule compliance is substantially reduced by both ambiguity and bad examples, but their combined effect is equivalent to each factor on its own. Ambiguity and bad examples each induce frequent rule violations, in which participants exploit the wiggle room and opportunistically break the rule to increase their payoffs. Follow-up experiments show that ambiguity weakens social norms against rule bending, and bad examples lowers people’s expectations of others’ compliance. Our results elucidate how social order is maintained and identify key factors that provoke collective rule-breaking.

Introduction

The smooth functioning of societies depends on individuals following rules that regulate their behavior, helping to coordinate collective action and foster social order (Bicchieri, 2005; Heyes, 2023; Posner, 2014). Although rules - such as laws, health and safety guidelines, and codes of conduct - are typically designed to serve collective interests, compliance often runs against individuals' short-term self-interest, requiring them to incur costs in terms of time, effort, or financial resources (*e.g.*, serving on a jury, social distancing during a pandemic, or paying taxes). Authorities may enforce rules by monitoring behavior and sanctioning violations (Allingham & Sandmo, 1972; Becker, 1968), but actual enforcement is often unlikely or impossible (Kliemt, 2020; Parsons, 1968; Smith, 2010). As a consequence, social order in society largely depends on individuals following rules voluntarily.

Empirical evidence shows that rule compliance is common, even when self-serving violations are not formally sanctioned (Gächter et al., 2023; Gross & Vostroknutov, 2022). Voluntary compliance may rely, for instance, on an individual's sense of civic duty (Hart & Green, 2012; Kliemt, 2020) or concerns that rule violations may hurt others (i.e., social preferences; Fehr & Schmidt, 1999; Kimbrough & Vostroknutov, 2016). Perhaps the most prominent reason for voluntary rule compliance is people's desire to conform to social norms that set expectations of compliance (Bicchieri, 2005; Cialdini et al., 1990; Desmet & Engel, 2021; Deutsch & Gerard, 1955; Fehr & Schurtenberger, 2018; Sherif, 1936). That is, people may follow rules because violating them would meet social disapproval ('injunctive norms'), or because they expect others to comply as well ('descriptive norms'). When these social norms are weak, however, voluntary compliance can rapidly break down (Bicchieri et al., 2022; Dimant, 2019; Isler & Gächter, 2022): observing "bad examples" of rule breaking tends to induce more non-compliance (Gächter et al., 2023; Molleman et al., 2022), which in turn can undermine a rule's normative appeal (Bear & Knobe, 2017; Lindström et al., 2018; Sunstein, 2023). These social influence effects can set off a dynamic of collective rule-breaking and fuel the spreading of disorder (Andreoni et al., 2021; Granovetter, 1978; Keizer et al., 2008; Krause et al., 2021).

Research in this area typically focuses on rules that leave little room for interpretation about what constitutes compliance, and what constitutes violation. Although in many situations in everyday life, rules apply unambiguously (*e.g.*, refrain from aggression, do not steal, respect scientific data integrity), many other rules entail gray areas in which the distinction between compliance and violation is unclear. These gray areas may arise when a rule does not explicitly cover some behaviors or completely describe the conditions necessary for the rule to apply. or when other people's actions do not align with a rule. This creates "wiggle room" for individuals to interpret the rule to their own advantage. Examples of such ambiguity abound in domains ranging from finance (exploiting tax loopholes, creative accounting) to education (grade inflation, using ChatGPT as an essay co-writer), and from sportsmanship (time wasting, using performance-enhancing drugs) to research and development (sharing copyrighted images, developing a product similar to a competitor's patented technology; Gächter & Schulz, 2016; Loland, 2001; March et al., 2000; OECD, 2019; Posner, 2014).

Despite the prevalence of rule ambiguity in everyday life, its effects on compliance are poorly understood. On the one hand, ambiguity may lead to the exploitation of wiggle room (i.e. more rule violations) and weaken social norms. On the other hand, ambiguity may make individuals more cautious, and therefore more rule compliant. Similarly, ambiguity may amplify or reduce the influence of peers depending on whether the individual feels more compelled to imitate others' example (*e.g.*, Huh et al., 2014; Venema et al., 2020) or to be more prone to follow internal motivations when there is ambiguity (*e.g.*, Haisley & Weber, 2010). We hypothesized that ambiguity and peer behavior impact rule compliance, and social norms of compliance. We did not commit to directional hypotheses because we expected that the effect of ambiguity may go in either direction.

In this paper, we report on incentivized experiments that examine how ambiguity shapes voluntary compliance with individually-costly rules and the sway of social influence. We employed a between-subjects 2 x 4 design with treatments varying (i) ambiguity (being absent or present); and (ii) the behavior of a 'peer' (who violated the rule outright, bent the rule, or complied with the rule). In baseline treatments, we did not show any peer behavior. Study 1 consists of a behavioral task to measure rule compliance in these conditions. Study 2 aims to clarify the underlying mechanisms of compliance by measuring social norms, gauging how ambiguity and observing others' behavior change social norms, that is, the extent to which people disapprove of rule violations (injunctive norms), and expect others to follow the rule (descriptive norms).

Methods

General procedures. We conducted two studies. Study 1 was a behavioral experiment. Study 2 measured injunctive and descriptive norms (total n=3,226). As per our pre-registration (osf.io/fqmuk; including power analysis), we aimed for 200 participants in each treatment of each study. Participants were all located in the USA, and were recruited on Prolific in October 2022 (Study 1) and February 2023 (Study 2). In both studies, the mean age was around 39 (*SD*=13.5; range 18-93), and 49% of participants identified as male (see Table S1 for sample details).

Experiments were programmed in LIONESS Lab (Giamattei et al., 2020) and are available in editable form from the LIONESS Lab repository (see Supplemental Information, section 4 for all experimental screens and how to access the experimental code). After providing informed consent, participants received instructions, including an animation walking them through the sequence of events in the task. Participants had to correctly answer control questions before they could complete their task. They knew that their decisions were incentivized and that no deception would be used throughout the experiment. Each of the studies ended with a questionnaire to record participants' age and gender. The studies were approved by the Ethics Review Board of the School of Social and Behavioral Sciences of Tilburg University (ref. RP621).

Study 1: Behavioral task. We examined rule compliance using a variant of a task involving a traffic light (Gächter et al., 2023; Kimbrough & Vostroknutov, 2016). Participants (n=1,620) had to move a circle to a red traffic light and then to a finish line (Fig. 1A). They were initially endowed with 20 points (worth £1.00 in total) which decreased by 1 point each second until they reached the finish line. This means that participants would earn the most by moving to the finish line as fast as possible. However, the instructions explicitly stated that "the rule is to wait until the traffic light turns green", so participants knew that rule compliance would be costly to them. Participants also knew that violations would not be punished, so that compliance would be voluntary.

Participants completed this task once. Experimental session lasted 12 minutes on average (this included subsequent tasks the data of which is not reported here; see Supplemental Materials, section 1 for details). The average payment was £2.10 (including payment for the unreported task; flat fee: £1.00; average bonus: £1.10; range £0.05- £1.80), making for an average hourly wage of £10.50.

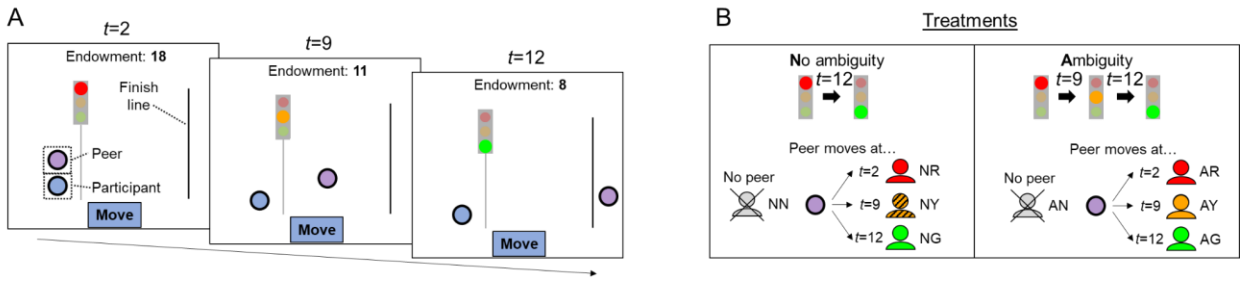


Fig. 1. Behavioral task. A. Participants controlled a blue circle figure that they had to move across the screen over the finish line. They were told that the rule is to wait at the traffic light until it turns green. Their initial endowment of 20 points reduced by 1 point each second, until they reached the finish line. When they clicked the 'move' button, their circle moved and stopped to wait at the traffic light; clicking again would move the circle over the finish line. The purple circle showed the movements of a previous participant (a 'peer'). **B.** Experimental treatments varied with respect to rule ambiguity, and peer behavior. The two letters abbreviations of treatment names respectively indicate ambiguity (N: no ambiguity; A: ambiguity), and the time point at which the peer moved across the screen (N: No peer, R: red, Y: yellow, or G: green).

Experimental treatments. To study the effect of rule ambiguity and peer behavior on compliance, we implemented 8 treatments in a between-subject 2 (ambiguity) x 4 (peer) design. In each treatment, the rule was the same, that is, to wait at the traffic light until it turns green. In treatments without ambiguity, the traffic light changed from red to green after 12 seconds (when the participants' endowment had decreased to 8 points; Fig. 1B). In treatments with ambiguity, the traffic light first turned from red to yellow after 9 seconds, and turned green after 12 seconds. The instructions included an animation to give participants full information about the color sequence of the traffic light they would face.

We operationalized ambiguity by showing a yellow light in between the red and the green light. The yellow light aimed to create "wiggle room" for participants to interpret the situation to their

own advantage, and break the stated rule of waiting on green. Yellow lights are known to have less strong action-link associations than red and green lights (which are clearly associated with 'stop' and 'go', respectively; Blizzard et al., 2017; Calvi et al., 2022). In addition, a yellow light after red and before green misaligns with US traffic standards (US Federal Highway Administration, 2022), likely generating further ambiguity due to 'schema-inconsistency' for the American participants in our sample (Whittlesea & Williams, 2001). In the baseline no-peer treatments, participants completed the task without observing movements of another participant, providing a clean test of how ambiguity impacted rule compliance.

To examine how social influence operates in these settings, treatments varied in the behavior of a 'peer', whose decision was recorded in a pre-test (Fig. 1B). Across treatments, the peer moved either at 2 seconds (immediately when reaching the traffic light, jumping the red light; violating the rule; shorthanded with 'R' for red), at 9 seconds (when the traffic light had turned yellow in the treatments with ambiguity; bending the rule; shorthanded with 'Y' for yellow, despite that in the treatments without ambiguity the traffic light was still red), or at 12 seconds (when the traffic light had turned green; complying with the rule; shorthanded with 'G' for green).

Study 2: Measuring social norms. To examine how injunctive and descriptive social norms are affected by ambiguity and peer behavior we used incentivized methods (Gächter et al., 2023; Krupka & Weber, 2013). A second set of participants (n=1,606; see Table S1 for sample details) completed two tasks in random order. Each participant was randomly allocated to read a description of one of the 8 treatments described above.

Injunctive norms task. In one task, we used an established incentive-compatible method to measure injunctive social norms, that is, the extent to which people think rule compliance and violations are generally deemed socially (in)appropriate (Krupka & Weber, 2013). We asked participants to read the instructions that a previous participant in the behavioral experiment (called "Person A") received. Participants then read a description of the decision setting of Person A. Where applicable, this description included the ambiguity (yellow light) and/or the peer's behavior (cf. the treatments described above).

Participants subsequently rated their perception of the social appropriateness of three possible actions that Person A could take (in random order): moving at 2 seconds, moving at 9 seconds, or moving at 12 seconds. Rating options were 1) very socially inappropriate, 2) somewhat socially inappropriate, 3) somewhat socially appropriate, and 4) very socially appropriate. Participants knew that, after the session was over, they would be randomly matched to another participant in their treatment. If their rating for one randomly selected action was the same, the bonus payment of both participants was increased by £1.00.

Descriptive norms task. In the other task, we measured descriptive norms, that is, people's perceived degree of rule compliance by others. Following the methods used in Gächter et al., (2023), we asked participants to guess the number of previous participants (out of 100) in each of three categories: those who moved between 2 and 9 seconds, between 9 and 12 seconds, and after 12 seconds. Participants were rewarded for accuracy: after the session was over, one

of the three categories was randomly chosen, and if participants were within 5 percentage points off the actual percentage in the behavioral task in that treatment, their bonus was increased by £1.00.

Participants took on average 4 minutes to complete both social norms tasks. Mean payment was £0.89 (flat fee: £0.50, average bonus: £0.39; range £0.00 - £1.00; mean hourly wage: £10.69). As per our pre-registration (https://osf.io/fqmuk), we pooled the data for both orders of tasks after confirming that the order did not impact the results (ANOVAs: interaction treatment *x* task order: $p > .05$ for each of the key response variables reported in Tables S5 and S8).

Statistical analysis. For ease of interpretation, our main regressions fitted to the behavioral data are based on linear probability models, using the treatment without ambiguity and without peers as the reference category. Conclusions from reported results are the same when using binomial models instead (for analysis code, see the OSF repository associated with this paper: https://osf.io/fqmuk). We provide an overview of the factors that contribute to explaining behavior in our studies by presenting ANOVAs for each of the three tasks. For the behavioral task, we report Cohen's *h* to qualify effect sizes (proportion differences) where appropriate. Our main focus is on rates of compliance (moving on green) across conditions.

In subsidiary analyses we fitted linear probability models to characterize proportions of behavior across the task sequence. The linear models were fitted to decisions to move between 2 and 9 seconds (on red), and to decisions to move between 9 and 12 seconds (yellow in the treatments with ambiguity, red in treatments without ambiguity) conditional upon not having moved on red yet. This latter model (which we label 'conditional yellow') allows for quantifying effects of the yellow light - and peers breaking the rule after a time lag - by omitting cases where participants had already moved on red, and thus had not experienced the crucial treatment. As a robustness check we also fitted multinomial models to all behaviors simultaneously.

To analyze descriptive norms, we used linear models fitted to the numerical values corresponding with each of the responses (1-4; see above; Krupka & Weber, 2013), and effect sizes expressed as Cohen's *d*. As a robustness check, we present linear mixed models to responses with 'participant' as random intercept. For descriptive norms, we used linear regressions fitted to each of the responses of interest separately. We report linear models fitted to participants estimates of others moving on red and on green, and 'conditional yellow' (the proportion of participants expected to move on yellow, conditional upon not having moved on red). Multinomial and Dirichlet regressions accounting for the dependency in the data (i.e., each participant's estimates had to sum to 100, so estimates were not independent) did not lead to different conclusions from those reported below.

Results

Behavioral experiment. When the rule was unambiguous and peers were not present (NN treatment), 58% of participants followed the rule and waited for the light to turn green (Fig. 2A; green bar). This compliance level is very similar to those observed in recent studies with the

same paradigm (58%; Gächter et al., 2023). Ambiguity reduced rule compliance to 39% in the absence of peers (Fig. 2B; AN; *h*=-0.383; Tukey test: *p*<.001; Table 1A, S2). This reduction was entirely driven by participants moving between 9 and 12 seconds: in the NN treatment, this fraction is very small (Fig. 2A; yellow hatched bar), while it is considerably larger in the AN treatment (Fig. 2B; yellow bar). Although the monetary consequences of moving between 9 and 12 seconds are the same between the two treatments, the crucial difference is that this is the time frame where the traffic light turned yellow in the AN treatment. The proportion of participants moving on red was unchanged by ambiguity, which is unsurprising since participants who violated the rule outright already moved before the light turned yellow in the AN treatment.

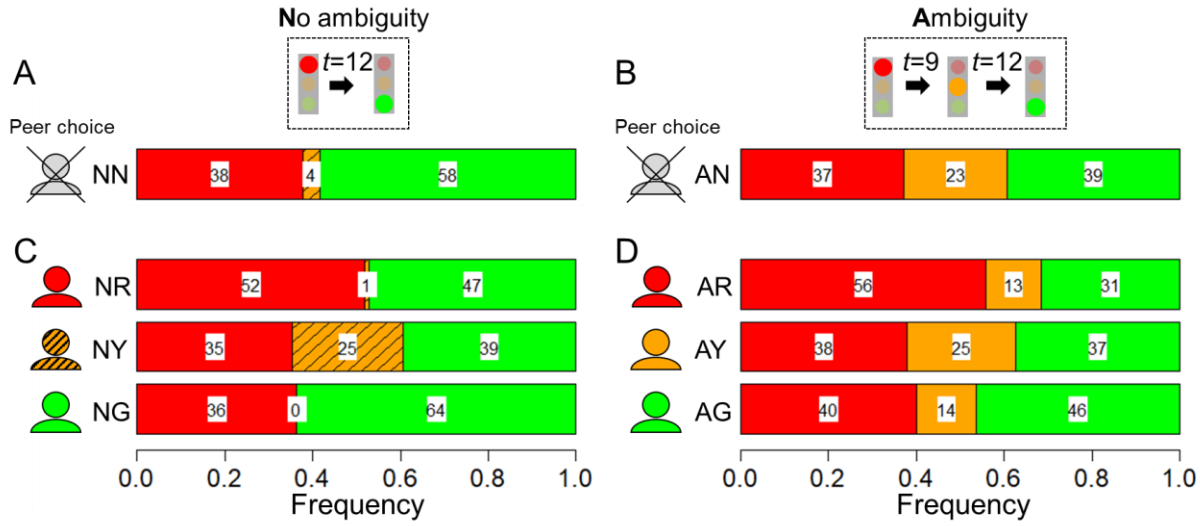


Fig. 2. Frequencies of behavior across experimental treatments. Bars show portions of participants in each treatment moving on red, yellow (between 9 and 12 seconds in treatments without ambiguity) and green. A and B show behavior in the absence of peers, without and with ambiguity, respectively. C and D show behavior in the presence of peers. Numbers in the bars show percentages of cases. Fig. S1 shows the distribution of movements across time. Table S1 shows demographic details of participants in each of the 8 between-subjects treatments.

Observing peer behavior strongly impacted rule compliance (Fig. 2C; Table 1A; $F(3)=12.95$; $p<.001$). In the absence of ambiguity, compared to the baseline of 58% compliance without peers (NN treatment; Fig. 2A), compliance went down to 47% when participants observed a peer who moved immediately when reaching the red traffic light (*h*=-0.226; Fig 2C, NR). When the peer moved after 9 seconds (NO), compliance reduced to 39% (*h*=-0.381). Observing a compliant peer (NG) only slightly increased participants' own compliance, to 64% (*h*=0.108), confirming recent findings (Gächter et al. (2023); see Table S3 for statistical tests).

Relative to the baseline without peers and without ambiguity, adding ambiguity reduced compliance, and so did observing a peer move on 9 seconds (Fig. 2, compare NN to AN and NY). However, both factors combined did not reduce compliance any further (Fig. 2D; AY; *h*=-0.041 and h=-0.038; Table S2, S3). This suggests that ambiguity and peer behavior are

substitutes: participants may opportunistically break the rule as soon as a convenient justification arises, being either ambiguity or observing rule bending. Ambiguity did not modulate compliance when the peer waited on green (AG vs AN) or when the peer moved immediately upon reaching the red light (AR; see Table S3 for statistical contrasts).

Interestingly, in the AR treatment (where the peer moved on red), 13% of participants moved on yellow (Fig. 2D), perhaps because they could self-servingly break the rule while behaving less "badly" than the peer they observed. Although the compliance rate was the lowest in this treatment, it did not fall below 31%. This indicates that for a substantial portion of participants, their willingness to comply with the rule trumped incentives for violation, the wiggle room created by rule ambiguity, and observing non-compliant peers.

A. Behaviour		**red**		**conditional yellow**		**green**	
	d.f.	**F**	**p**	**F**	**p**	**F**	**p**
ambiguity	1	0.92	0.339	63.04	<0.001	30.52	<0.001
peer behaviour	3	11.38	<0.001	26.23	<0.001	10.82	<0.001
ambiguity x peer behavior	3	0.17	0.915	7.65	<0.001	2.57	0.053
Residuals (d.f.)		1612		939		1612	

B. Normative beliefs		**red**		**yellow**		**green**	
	d.f.	**F**	**p**	**F**	**p**	**F**	**p**
ambiguity	1	5.56	0.019	133.64	<0.001	3.65	0.085
peer behaviour	3	3.70	0.012	3.51	0.015	2.94	0.032
ambiguity x peer behavior	3	2.20	0.086	0.69	0.560	3.10	0.025
Residuals (d.f.)		1598		1598		1597	

C. Descriptive beliefs		**red**		**conditional yellow**		**green**	
	d.f.	**F**	**p**	**F**	**p**	**F**	**p**
ambiguity	1	1.38	0.241	3.28	0.070	1.17	0.279
peer behaviour	3	17.60	<0.001	10.27	<0.001	10.38	<0.001
ambiguity x peer behavior	3	5.57	<0.001	1.52	0.209	3.47	0.016
Residuals (d.f.)		1524		1596		1598	

Table 1. Determinants of compliance and social norms. ANOVA results stem from linear models fitted to responses in the behavioral task (A), and injunctive and descriptive norms in the social norms tasks (B and C, respectively). F-statistics indicate what factors drive responses in each of the tasks (with higher values having more explanatory power). Directions of the effects and shown in Figures 2-4; model estimates and contrasts between treatments are shown in Tables S2-7.

Injunctive norms. Figure 3 shows how ambiguity and peer behavior influenced normative ratings of each of the possible behaviors of the focal participant across treatments. Moving immediately on red was generally deemed (very) socially inappropriate, irrespective of ambiguity or peer behavior (Fig. 3A; range *M*=[1.46-1.76], *SD*=[0.71, 0.88]). Waiting on the green light was deemed very socially appropriate (Fig. 3C; *M*=[3.48, 3.80], *SD*=[0.59, 0.95]]). Overall, normative ratings for moving immediately on red or waiting on green did not differ much across experimental treatments (squares in Fig. 3A and 3C tend to be close together, and close to the horizontal line indicating ratings in the no-peer baseline treatment (NN); Table S5).

In the absence of ambiguity and peers, moving at 9 seconds (when the traffic light was still red) met only slightly less disapproval than moving immediately (M_{NY}=1.81, SD_{NY}=0.74; Fig. 3A, B, horizontal lines). Relative to this baseline, in the presence of ambiguity, moving at 9 seconds - when the traffic light had turned yellow - met substantially less disapproval (M_{AY}=2.49, SD_{AY}=0.75; Fig. 3B, solid squares are above the horizontal line and above the open squares; d=0.694; p<.001; Table S4). In the latter case, ratings were often intermediate, with many participants evaluating rule bending as 'somewhat socially inappropriate' or even 'somewhat socially appropriate' (Fig. S2). This suggests that ambiguity weakens norms against rule breaking, and that many people do not disapprove of others exploiting the wiggle room created by ambiguity. Overall, violations met slightly more disapproval when peers complied than when peers violated too (i.e., squares on the right-hand side in panels Fig. 3A,B are lower than the squares in the middle), but these effects were not systematically modulated by ambiguity (Table 1B, S7).

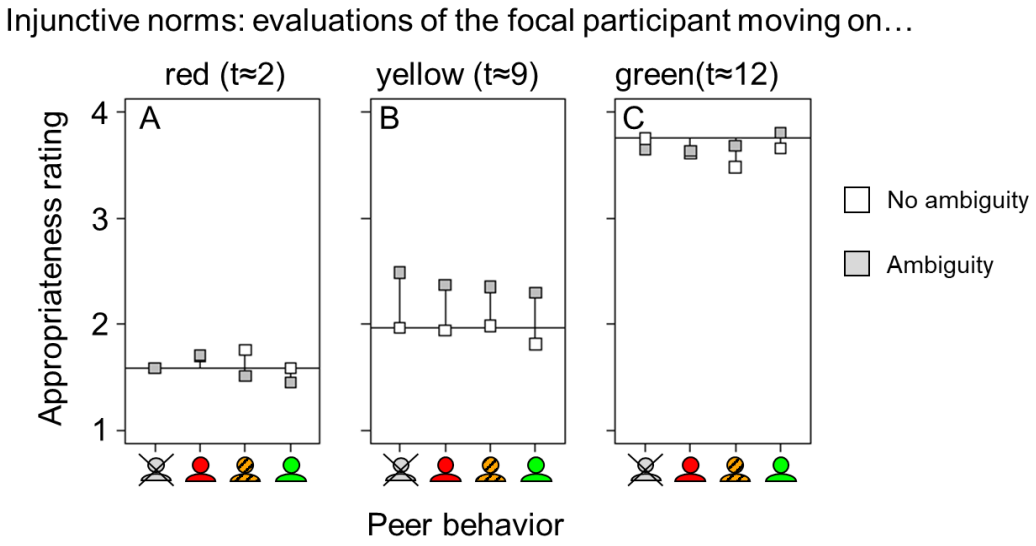


Fig. 3. Injunctive norms across treatments. Squares show average appropriateness ratings for three possible actions of the focal participant (panels A,B,C: red, yellow/late-red, green). Horizontal lines show average ratings in the no-peer baseline treatment without ambiguity (NN). Solid and open squares respectively show treatments with and without ambiguity, with deviations from the baseline treatment. Within each panel, the horizontal axis shows the four peer treatments. The two leftmost open squares in 3A are hidden behind solid ones, indicating very similar ratings in treatments with and without ambiguity. For a full breakdown of participants' responses across possible actions and treatments, see Fig. S2.

Descriptive norms. Figure 4 shows how ambiguity and peer behavior changed descriptive norms, that is, participants' expectations of others' behavior in the task. In the absence of peers, ambiguity reduced expectations of compliance (from 55% to 48% on average; d=-0.286; p=.015; cf. Fig. 4C; Table 1C, Table S7), largely because participants expected many others to move when the light turned yellow (Fig. 4B; d=0.277; p=.028; Table S7, S8).

The effects of peer behavior on descriptive norms was in line with what we observed in our behavioral experiment. Participants expected others to copy observed rule violations (peers moving on yellow or on red; increased estimated frequencies of others moving on red and yellow in Fig. 4A and B, respectively). Compared to the baseline treatment (NN), expected compliance rates were 8 percentage points lower when the peer moved on red, and 7 percentage points lower when the peer moved on yellow (Fig. 4C, open squares; d=-0.339 and d=-0.320; p<.001 and p=.001, respectively; Table S8). By contrast, observing a complying peer did not increase expected compliance rates (d=-0.095; p=.338; Table S7), which is also in line with the results from our behavioral experiment. We do not observe systematic interaction effects between ambiguity and peer behavior (Fig. 4 solid squares; Table S7).

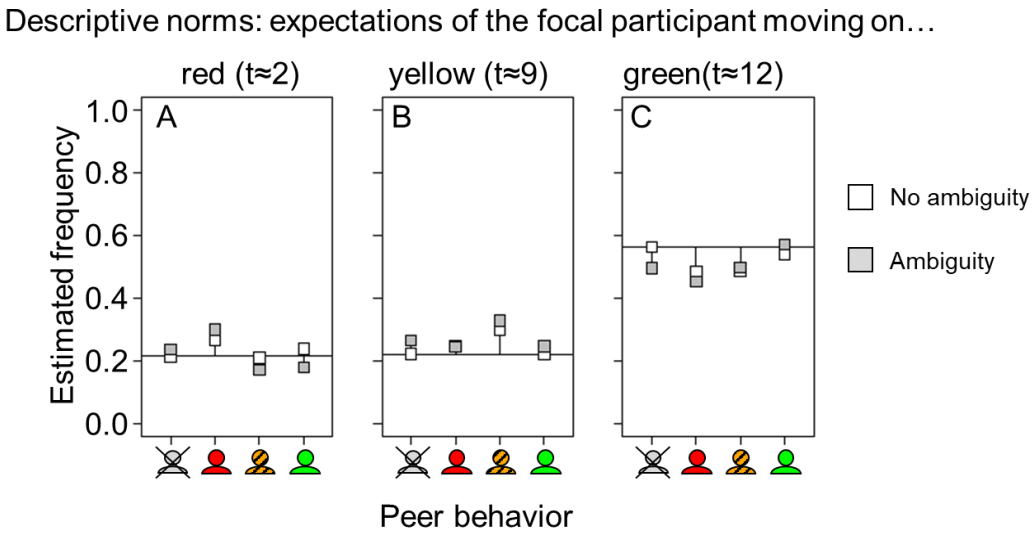


Fig. 4. Descriptive norms across treatments. Squares show average estimated frequencies of three possible actions (three panels). Horizontal lines show average estimated frequencies in the no-peer baseline treatment without ambiguity (NN). Solid and open squares respectively show treatments without and with ambiguity, with deviations from the baseline treatment. Within each panel, the horizontal axis shows the four peer treatments. For a full breakdown of participants' responses across possible actions and treatments, see Fig. S3.

Taken together, our experiments on social expectations show that ambiguity weakens injunctive norms by reducing disapproval of rule bending (Fig. 3B). Peer behavior shapes descriptive norms in an asymmetric way: observing violations is expected to reduce compliance, but observing compliance is not expected to increase compliance.

Discussion

Our experiments elucidate the individual-level processes of rule compliance that underlie the maintenance of social order in societies. The results can be summarized in three main points. First, ambiguity substantially decreases rule compliance. Second, observing peers violating a

rule also strongly decreases compliance, but the combined effect of such “bad examples” and ambiguity is equivalent to either effect on its own. Third, ambiguity and bad examples erode social norms that support rule-following: ambiguity weakens disapproval of non-compliance, and observing a violation reduces people’s expectations of others to comply.

Our behavioral experiment shows that ambiguity substantially reduces rule compliance (Fig. 2A,B). Many participants moved when the traffic light turned yellow. This suggests that many people would exploit the wiggle room created by the yellow light, bending the rule in a self-serving way. It seems plausible that the mechanisms underlying this behavior are similar to those involved in situations where ambiguity makes people more selfish (Haisley & Weber, 2010) or more dishonest (Dana et al., 2007; Grossman & van der Weele, 2017; Pittarello et al., 2015) as ambiguity might provide people with a good excuse for non-compliance while preserving a good self-image (Bicchieri et al., 2023; Bodner & Prelec, 2003). Our study forms a good starting point for future research to examine links between individuals’ rule-breaking, selfishness, and dishonesty - as well as individuals' tendencies to opportunistically exploit ambiguity in those domains.

The effects of peer behavior on compliance were asymmetric. In line with observations in the context of pro-sociality (Bicchieri et al., 2022; Charness et al., 2019; Dimant, 2019; Thöni & Gächter, 2015), observing self-serving rule bending or violation strongly reduced compliance, and observing a compliant peer did not increase compliance much. Taken at face value, the disproportionate influence of bad examples suggests that observing others might primarily work against collective interests when rule compliance is costly to the individual. However, in our experiments, violations did not hurt other people, and participants made their decisions anonymously, without being observed by others. In face-to-face interactions with similar or familiar others, or when actions may have consequences for others, social influence effects may be more symmetric (Bicchieri et al., 2022), and good examples might foster collective rule compliance. Moreover, being observed by others might inhibit opportunistic interpretations of ambiguous situations, because in those cases, exploiting wiggle room to one’s own advantage may hurt not only one’s self-image, but also one’s social image (Bénabou & Tirole, 2006; Gross & Vostroknutov, 2022).

Our results show that the isolated effects of ambiguity (AN treatment; Fig. 2B) and observing a peer bending the rule (NY; Fig. 2C) were as strong as the effect of both factors combined (AY; Fig. 2D). This “substitution effect” of ambiguity and observing rule bending suggests that some people are sensitive to either cue, perhaps because both cues introduce uncertainty regarding the applicability of the rule. These people may opportunistically bend a rule as soon as a reason presents itself to justify self-serving non-compliance, while others might be unconditional rule-followers or unconditional rule-breakers. Our between-subject administration of experimental treatments, however, does not allow for directly addressing this idea. Future experiments using within-subject designs may explore the existence of ‘types’ of individuals who either follow or violate rules regardless of the circumstances, and others who condition their compliance on external signals (including social norms (Desmet & Engel, 2021); as has been described in the

context of learning problems and cooperation settings (Fischbacher et al., 2001; Molleman et al., 2014; Toelch et al., 2014).

Although our behavioral data suggests that ambiguity and observing rule violations rely on the same mechanisms that lead to opportunistic rule-breaking, our experiments on social norms indicate that this is not the whole story. Ambiguity strongly weakens injunctive norms by reducing disapproval of rule bending (Fig. 3B), whereas peer violations weaken descriptive norms by reducing expectations of others' compliance (Fig. 4C). Together, these results suggest that the power of norms for supporting rule compliance can rapidly wane under the joint presence of ambiguity and bad examples. Such norm erosion can start a downward spiral leading to collective rule breaking (Andreoni et al., 2021; Gavrilets, 2020; Gavrilets & Richerson, 2017): a lack of social disapproval likely invites more violations (Desmet & Engel, 2021), and with more and more people violating a rule, the rule itself might lose its normative appeal (Lindström et al., 2018). Our data shows one hopeful sign that observing peer violations did not strongly reduce disapproval of violations (Fig. 3). This result seemingly contrasts with recent findings that disapproval of rule violations weakened with observing violations (Lindström et al., 2018; Gächter et al. 2023). This discrepancy may be because substantial changes in injunctive norms may require the observation of a larger group of peers rather than the single peer that participants in our study observed.

In our experiments, the traffic light turning yellow aimed to generate ambiguity about the applicability of a simple rule. The effects we observed in our experiments might be specific to the context of a traffic light. Different operationalizations of ambiguity and how individuals observe peer behavior might have different effects on rule compliance. Moreover, 'situational' ambiguity as studied in our experiment (in which the yellow light makes it unclear whether or not moving is in line with the rule) might not be the only type of ambiguity impacting rule compliance and the sway of social influence in the real world (*e.g.*, Roefs et al., 2023). For example, ambiguity might also arise when rules are complex or partly in conflict with other rules. To address these limitations, future research may extend our experiments to examine (peer effects in) rule compliance when rules are stated in an ambiguous way, in conflict with other rules, when consequences for violations are unclear, or when rules are enforced in unpredictable ways.

In conclusion, our results show that ambiguity induces opportunistic rule breaking and erodes social norms. Our experiments expose responses to ambiguity and peer behavior and ambiguity at the individual level, paving the way for theoretical and empirical research mapping out how collective rule compliance can be best supported to foster social order in societies.

Data and code

Data and code are publicly accessible in the repository associated with this paper: https://osf.io/pdfbt/

References

Allingham, M. G., & Sandmo, A. (1972). Income tax evasion: A theoretical analysis. *Journal of public economics*, *1*(3-4), 323-338.

Andreoni, J., Nikiforakis, N., & Siegenthaler, S. (2021). Predicting social tipping and norm change in controlled experiments. *Proceedings of the National Academy of Sciences*, *118*(16), e2014893118. https://doi.org/10.1073/pnas.2014893118

Bear, A., & Knobe, J. (2017). Normality: Part descriptive, part prescriptive. *cognition*, *167*, 25-37.

Becker, G. S. (1968). Crime and Punishment: An Economic Approach. *Journal of Political Economy*, *76*(2), 169-217. https://doi.org/10.1086/259394

Bénabou, R., & Tirole, J. (2006). Incentives and Prosocial Behavior. *American Economic Review*, *96*(5), 1652-1678. https://doi.org/10.1257/aer.96.5.1652

Bicchieri, C. (2005). *The Grammar of Society: The Nature and Dynamics of Social Norms*. Cambridge University Press.

Bicchieri, C., Dimant, E., Gächter, S., & Nosenzo, D. (2022). Social proximity and the erosion of norm compliance. *Games and Economic Behavior*, *132*, 59-72. https://doi.org/10.1016/j.geb.2021.11.012

Bicchieri, C., Dimant, E., & Sonderegger, S. (2023). It's not a lie if you believe the norm does not apply: Conditional norm-following and belief distortion. *Games and Economic Behavior*, *138*, 321-354. https://doi.org/10.1016/j.geb.2023.01.005

Blizzard, S., Fierro-Rojas, A., & Fallah, M. (2017). Response Inhibition Is Facilitated by a Change to Red Over Green in the Stop Signal Paradigm. *Frontiers in Human Neuroscience*, *10*. https://www.frontiersin.org/articles/10.3389/fnhum.2016.00655

Bodner, R., & Prelec, D. (2003). Self-signaling and diagnostic utility in everyday decision making. *The psychology of economic decisions*, *1*(105), 26.

Calvi, A., D'Amico, F., Ferrante, C., & Petrella, C. (2022). *To stop, or not to stop, that it the dilemma: Evaluating the effects of safety countermeasures at signalized intersections during the yellow phase*. https://doi.org/10.54941/ahfe1002480

Charness, G., Naef, M., & Sontuoso, A. (2019). Opportunistic conformism. *Journal of Economic Theory*, *180*, 100-134. https://doi.org/10.1016/j.jet.2018.12.003

Cialdini, R. B., Reno, R. R., & Kallgren, C. A. (1990). A focus theory of normative conduct: Recycling the concept of norms to reduce littering in public places. *Journal of Personality and Social Psychology*, *58*(6), 1015-1026. https://doi.org/10.1037/0022-3514.58.6.1015

Dana, J., Weber, R. A., & Kuang, J. X. (2007). Exploiting moral wiggle room: Experiments demonstrating an illusory preference for fairness. *Economic Theory*, *33*(1), 67-80. https://doi.org/10.1007/s00199-006-0153-z

Desmet, P. T. M., & Engel, C. (2021). People are conditional rule followers. *Journal of Economic Psychology*, *85*, 102384. https://doi.org/10.1016/j.joep.2021.102384

Deutsch, M., & Gerard, H. B. (1955). A study of normative and informational social influences upon individual judgment. *The journal of abnormal and social psychology*, *51*(3), 629.

Dimant, E. (2019). Contagion of pro-and anti-social behavior among peers and the role of social proximity. *Journal of Economic Psychology*, *73*, 66-88.

Fehr, E., & Schmidt, K. M. (1999). A theory of fairness, competition, and cooperation. *The quarterly journal of economics*, *114*(3), 817-868.
Fehr, E., & Schurtenberger, I. (2018). Normative foundations of human cooperation. *Nature Human Behaviour*, *2*(7), 458. https://doi.org/10.1038/s41562-018-0385-5
Fischbacher, U., Gächter, S., & Fehr, E. (2001). Are people conditionally cooperative? Evidence from a public goods experiment. *Economics Letters*, *71*(3), 397-404. https://doi.org/10.1016/S0165-1765(01)00394-9
Gächter, S., Nosenzo, D., & Molleman, L. (2023). *Why people follow rules*.
Gächter, S., & Schulz, J. F. (2016). Intrinsic honesty and the prevalence of rule violations across societies. *Nature*, *531*, 496-499.
Gavrilets, S. (2020). The dynamics of injunctive social norms. *Evolutionary Human Sciences*, *2*, e60. https://doi.org/10.1017/ehs.2020.58
Gavrilets, S., & Richerson, P. J. (2017). Collective action and the evolution of social norm internalization. *Proceedings of the National Academy of Sciences*, *114*(23), 6068-6073.
Giamattei, M., Yahosseini, K. S., Gächter, S., & Molleman, L. (2020). LIONESS Lab: A free web-based platform for conducting interactive experiments online. *Journal of the Economic Science Association*. https://doi.org/10.1007/s40881-020-00087-0
Granovetter, M. (1978). Threshold Models of Collective Behavior. *American Journal of Sociology*, *83*(6), 1420-1443. https://doi.org/10.1086/226707
Gross, J., & Vostroknutov, A. (2022). Why do people follow social norms? *Current Opinion in Psychology*, *44*, 1-6. https://doi.org/10.1016/j.copsyc.2021.08.016
Grossman, Z., & van der Weele, J. J. (2017). Self-Image and Willful Ignorance in Social Decisions. *Journal of the European Economic Association*, *15*(1), 173-217. https://doi.org/10.1093/jeea/jvw001
Haisley, E. C., & Weber, R. A. (2010). Self-serving interpretations of ambiguity in other-regarding behavior. *Games and Economic Behavior*, *68*(2), 614-625. https://doi.org/10.1016/j.geb.2009.08.002
Hart, H. L. A., & Green, L. (2012). *The concept of law*. oxford university press.
Heyes, C. (2023). Rethinking Norm Psychology. *Perspectives on Psychological Science*, 17456916221112075. https://doi.org/10.1177/17456916221112075
Huh, Y. E., Vosgerau, J., & Morewedge, C. K. (2014). Social Defaults: Observed Choices Become Choice Defaults. *Journal of Consumer Research*, *41*(3), 746-760. https://doi.org/10.1086/677315
Isler, O., & Gächter, S. (2022). Conforming with peers in honesty and cooperation. *Journal of Economic Behavior & Organization*, *195*, 75-86. https://doi.org/10.1016/j.jebo.2021.12.026
Keizer, K., Lindenberg, S., & Steg, L. (2008). The spreading of disorder. *Science*, *322*(5908), 1681-1685.
Kimbrough, E. O., & Vostroknutov, A. (2016). Norms make preferences social. *Journal of the European Economic Association*, *14*(3), 608-638.
Kliemt, H. (2020). Economic and sociological accounts of social norms. *Analyse & Kritik*, *42*(1), 41-96.

Krause, J., Romanczuk, P., Cracco, E., Arlidge, W., Nassauer, A., & Brass, M. (2021). Collective rule-breaking. *Trends in Cognitive Sciences*, *25*(12), 1082-1095. https://doi.org/10.1016/j.tics.2021.08.003

Krupka, E. L., & Weber, R. A. (2013). Identifying social norms using coordination games: Why does dictator game sharing vary? *Journal of the European Economic Association*, *11*(3), 495-524.

Lindström, B., Jangard, S., Selbing, I., & Olsson, A. (2018). The role of a "common is moral" heuristic in the stability and change of moral norms. *Journal of Experimental Psychology: General*, *147*(2), 228.

Loland, S. (Red.). (2001). *Fair Play in Sport: A Moral Norm System*. Routledge. https://doi.org/10.4324/9780203479049

March, J. G., Schulz, M., & Zhou, X. (2000). *The Dynamics of Rules: Change in Written Organizational Codes*. Stanford University Press.

Molleman, L., Ciranka, S., & van den Bos, W. (2022). Social influence in adolescence as a double-edged sword. *Proceedings of the Royal Society B: Biological Sciences*, *289*(1977), 20220045. https://doi.org/10.1098/rspb.2022.0045

Molleman, L., van den Berg, P., & Weissing, F. J. (2014). Consistent individual differences in human social learning strategies. *Nature Communications*, *5*, 3570. https://doi.org/10.1038/ncomms4570

OECD, E. (2019). *Trends in trade in counterfeit and pirated goods*.

Parsons, T. (1968). *The structure of social action. Vol. 1*. Free Press.

Pittarello, A., Leib, M., Gordon-Hecker, T., & Shalvi, S. (2015). Justifications shape ethical blind spots. *Psychological science*, *26*(6), 794-804.

Posner, R. A. (2014). *Economic Analysis of Law*. Aspen Publishing.

Roefs, F. D., Hoogslag, M., & N. L. Olivers, C. (2023). Familiarity with beach warning flags in the Netherlands. *Safety Science*, *158*, 105952. https://doi.org/10.1016/j.ssci.2022.105952

Sherif, M. (1936). *The psychology of social norms* (pp. xii, 210). Harper.

Smith, A. (2010). *The Theory of Moral Sentiments*. Penguin.

Sunstein, C. R. (2023). Discerning blue from purple: How prevalence affects what is perceived as normal. *Evolution and Human Behavior*, *44*(3), 250-254.

Thöni, C., & Gächter, S. (2015). Peer effects and social preferences in voluntary cooperation: A theoretical and experimental analysis. *Journal of Economic Psychology*, *48*, 72-88. https://doi.org/10.1016/j.joep.2015.03.001

Toelch, U., Bruce, M. J., Newson, L., Richerson, P. J., & Reader, S. M. (2014). Individual consistency and flexibility in human social information use. *Proceedings of the Royal Society B: Biological Sciences*, *281*(1776), 20132864.

US Federal Highway Administration. (2022). *2009 MUTCD with Revisions 1, 2, and 3 incorporated, dated June 2022 (PDF)—FHWA MUTCD*. https://mutcd.fhwa.dot.gov/pdfs/2009r1r2r3/pdf_index.htm

Venema, T. A. G., Kroese, F. M., Benjamins, J. S., & de Ridder, D. T. D. (2020). When in Doubt, Follow the Crowd? Responsiveness to Social Proof Nudges in the Absence of Clear Preferences. *Frontiers in Psychology*, *11*. https://www.frontiersin.org/articles/10.3389/fpsyg.2020.01385

Whittlesea, B. W., & Williams, L. D. (2001). The discrepancy-attribution hypothesis: II. Expectation, uncertainty, surprise, and feelings of familiarity. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *27*(1), 14.

Acknowledgements

We would like to thank the members of the Connected Minds lab of the University of Amsterdam for constructive comments and discussions. This work was funded by the Centre for Integrative Business Psychology, Aarhus University (Seedcorn grant 2021), the Aarhus University Research Foundation (AUFF Starting Grant 36835), and the University of Amsterdam for ABC grant (Project grant 2022).

Authors contributions

LM: Conceptualization, experimental implementation and programming, data analysis and visualization, writing lead. DN: Conceptualization, co-writing, reviewing and editing. TV: Conceptualization, data collection, analysis, co-writing, reviewing and editing.

Supplemental Materials

For

Ambiguity induces opportunistic rule breaking and erodes social norms

By Lucas Molleman, Daniele Nosenzo and Tina Venema

Contents

1. Supplemental Methods

Our study reports results of three experiments, with tasks measuring (1) behavior, (2) injunctive norms, and (3) descriptive norms. The results in the main text report responses from 1,620 participants completing the behavioral task (1) and 1,606 additional participants completing the both tasks measuring injunctive and descriptive norms (2 and 3; in random order).

After completing the behavioral task, the 1,620 participants in experiment 1 also completed experiments 2 and 3. We aimed to measure participants' social norms in the setting that matched the treatment that they just experienced. However, this version of tasks 2 and 3 contained a programming error, such that the descriptions in tasks 2 and 3 did not match the participants' treatment (participants who did not experience ambiguity in task 1 were asked to indicate how many others they would expect to move on yellow, while the instructions nor the behavioral task they just completed mentioned a yellow light). We therefore refrain from reporting these results here. Instead, we only report the results from the between-subject experiments (separating task 1 from tasks 2 and 3), which has the additional benefit of avoiding spill-over effects from behavior to the measured social norms.

We deviated from the pre-registration (osf.io/fqmuk) in two ways: (1) the traffic light turned yellow after 9 seconds (rather than the pre-registered 7 seconds), because after programming the task, we noticed that leaving the light yellow for 5 seconds looked rather unnatural; (2) as robustness checks, we registered regressions that include controls of risk attitudes, patience, and participants' scores on the cognitive reflection test measured in experiment 1. Due to the likely confusion stemming from the programming error above, be refrain from analyzing these variables.

Furthermore, due to a technical issue on the OSF website the original preregistration text (d.d. 15 September 2022, prior to data collection) lacked part of the section on Analyses (that is, the text broke off in the middle of the paragraph on H2a). After two failed updates, we had a brief discussion with the OSF helpdesk it turned out that there was an issue with parsing inequality signs (< and >), and they kindly solved this technical issue. We updated the preregistration text to the correct version on 8 November 2023 (after data collection). Note that this version still has the minor omission of lacking the second inequality in the following sentence from the Analyses section: "To test whether peer behavior changes rule compliance, we will quantify for model (i) the relative support for the order constraints N1<N2<N3=N0 and N1=N2<N3=N0, using the function BF() in the R package 'BFpack' (Mulder et al. 2019)."

In the post-experimental questionnaires, we asked participants, in addition to entering their age and gender, whether they had participated in similar rule-following tasks in the past. This was the case for 21 of the 1,620 participants (1.3%) in Study 1, and 39 of the 1,606 participants (2.4%) in Study 2. Excluding these participants from the analyses did not change any of the results presented in our paper, so we retain them in all analyses.

2. Supplemental Figures

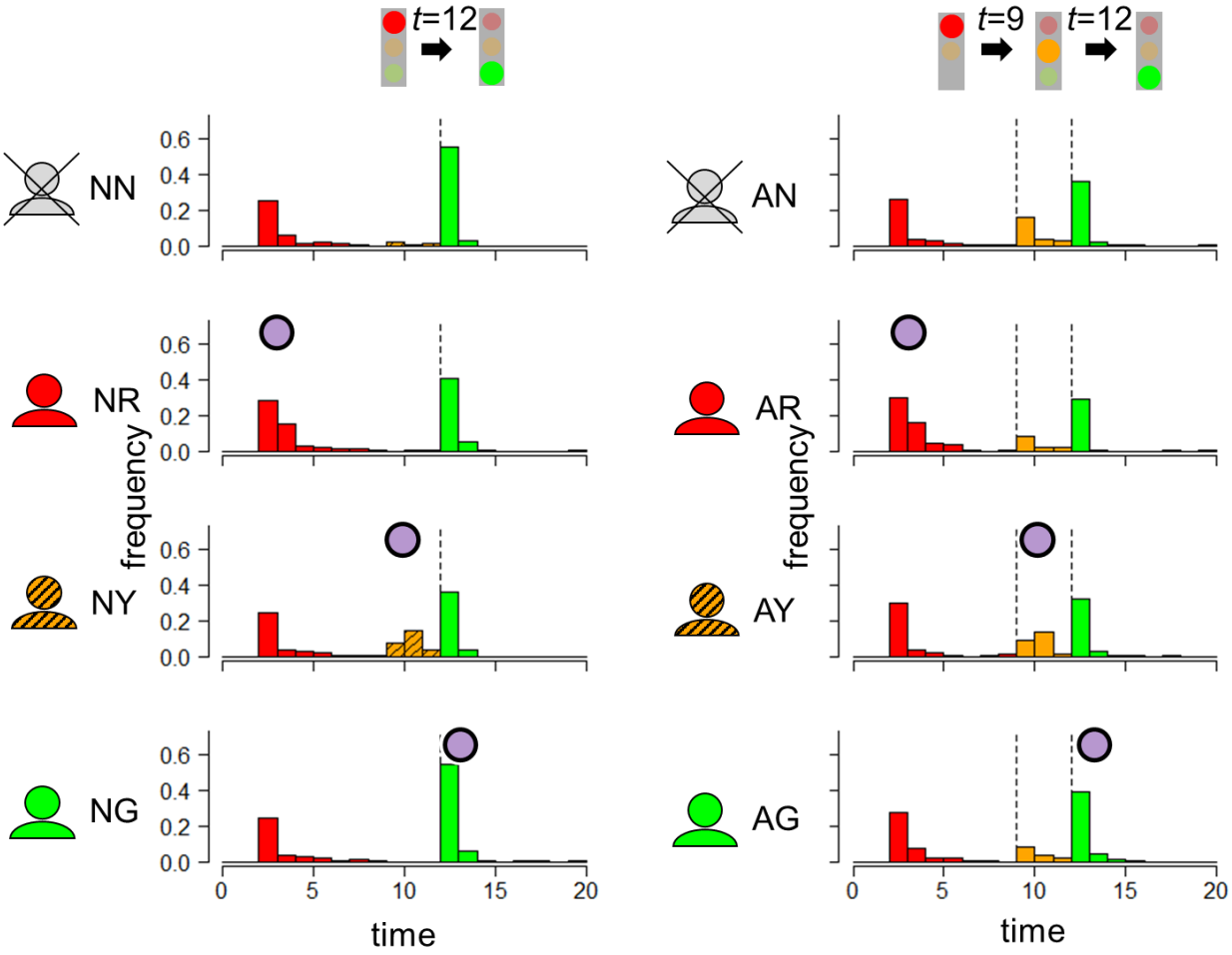


Figure S1. Timing of movements in each of the treatments. Bars show frequency of clicks across time in the task. Vertical dotted lines indicate when the traffic light changed color. The purple circle indicates when the peer moved towards the finish line (cf. Fig. 1 of the main text). We observe that participants strongly respond to the signal; there is a large peak right after the traffic light turns green (after 12s). This indicates that participants understand the task.

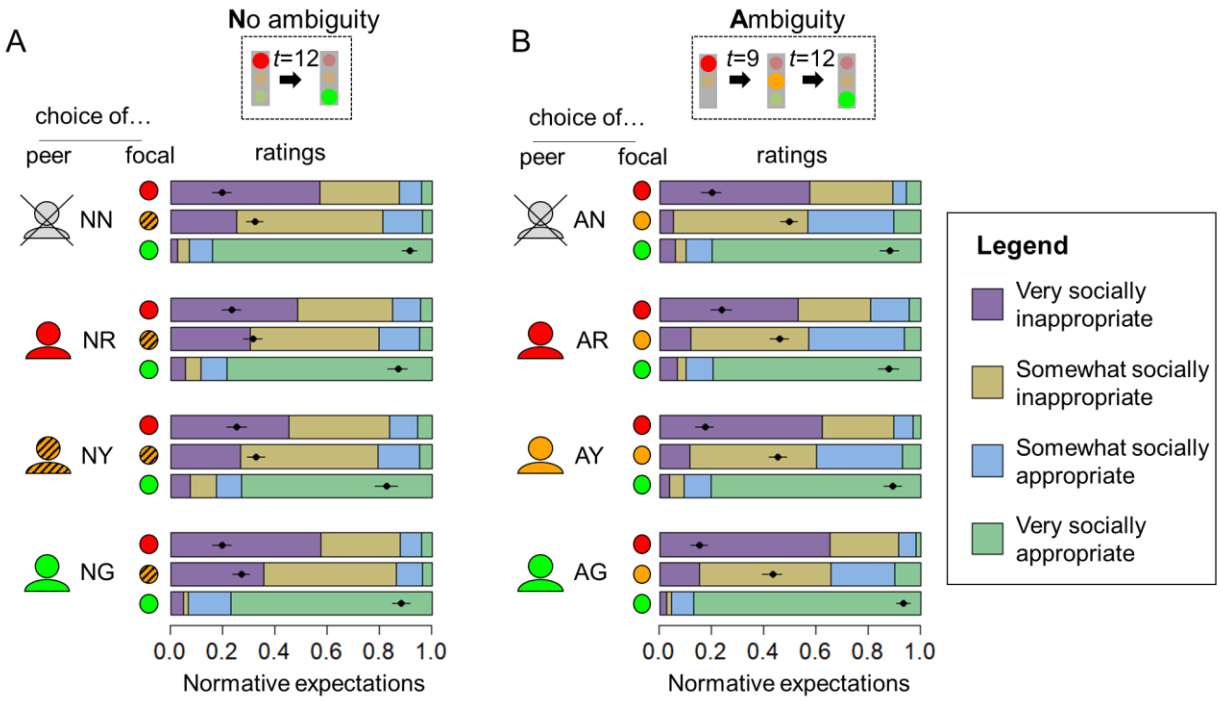


Fig. S2. Distributions of normative ratings across experimental treatments. The eight triples of stacked bars show distributions of appropriateness ratings for three possible actions of the focal participant (red, yellow/late-red, green). A. Treatments without ambiguity. B. treatments with ambiguity. Bars indicate relative frequencies of ratings. Lines and dots inside the stacked bars show the mean rating (normalized to the range 0-1) +/- 1 SEM.

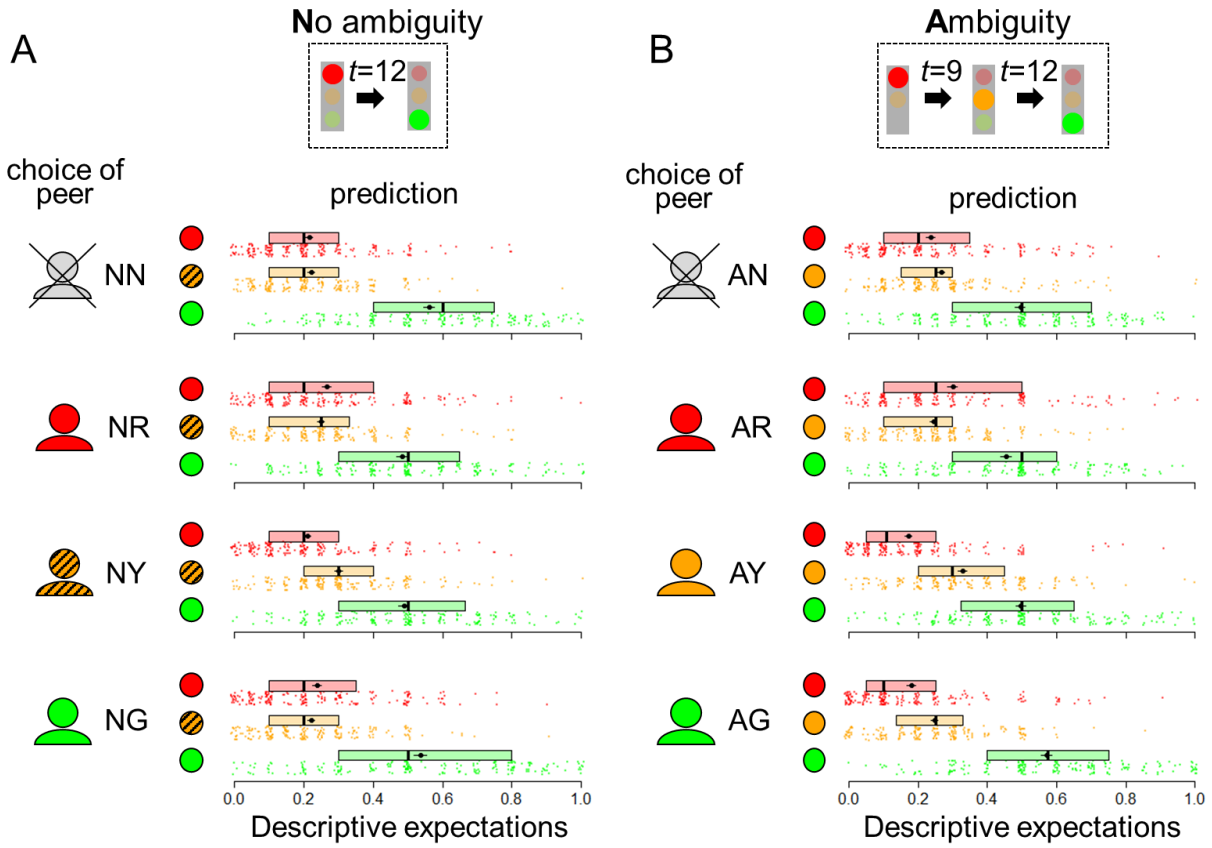


Figure S3. Distributions of descriptive norms across experimental treatments. Each dot shows a participant's estimated relative frequency of three possible actions. Participants rated three possible actions, so there are three dots per participant in a panel (summing up to 1). Boxes above show the first, second and third quartile; black dots with whiskers show mean +/- 1 S.E.M.

3. Supplemental Tables

	Behavioral experiment			Norms		
treatment	**N**	**%male:female:other**	**Mean age (sd) [range]**	**N**	**%male:female:other**	**Mean age (sd) [range]**
NN	204	52:45:2	38.8 (12.9) [18 - 81]	201	52:45:3	37.0 (12.5) [18 - 74]
NR	204	42:56:2	38.5 (13.9) [18 - 93]	208	53:45:2	37.3 (13.1) [18 - 85]
NY	203	53:43:3	39.2 (13.1) [20 - 77]	199	52:46:3	39.9 (13.9) [18 - 77]
NG	206	50:47:3	39.2 (13.4) [19 - 78]	204	44:53:3	37.5 (13.7) [18 - 72]
AN	196	48:50:2	38.6 (13.6) [19 - 77]	201	48:51:1	39.5 (14.2) [18 - 85]
AR	197	47:52:1	38.9 (13.3) [18 - 76]	193	50:48:2	38.6 (13.2) [18 - 72]
AY	203	48:51:0	39.3 (13.5) [19 - 76]	200	50:47:2	37.0 (13.5) [18 - 76]
AG	207	53:46:1	39.3 (13.3) [19 - 85]	200	46:52:1	39.2 (14.2) [18 - 75]
total	1620	49:49:2	39.0 (13.3) [18 - 93]	1606	50:48:2	38.3 (13.6) [18 - 85]

Table S1. Sample details. Participants were recruited from Prolific. Location was restricted to the United States, and we aimed for a 50/50 gender distribution. For treatment descriptions (with abbreviations), see Fig. 1 of the main text. For participants in Study 1 (behavioral experiment), 19 participants did not enter their age and gender (responses were made obligatory in Study 2). These participants were included in the main behavioral analyses (cf. Fig. 2), but they were omitted from the regressions including those variables.

	green	red	conditional yellow
AN vs NN	-0.19 [-0.29,-0.09], p<0.001	-0.01 [-0.10,0.09], p=1.000	0.31 [0.22,0.41], p<0.001
AR-AN vs NR-NN	0.03 [-0.10,0.17], p=0.950	0.04 [-0.09,0.18], p=0.896	-0.04 [-0.19,0.10], p=0.920
AY-AN vs NY-NN	0.17 [0.04,0.31], p=0.042	0.03 [-0.11,0.16], p=0.970	-0.30 [-0.44,-0.17], p<0.001
AG-AN vs NG-NN	0.02 [-0.12,0.15], p=0.995	0.04 [-0.09,0.18], p=0.907	-0.09 [-0.22,0.05], p=0.500

Table S2. Behavioral experiment: Contrasts between experimental treatments. Table shows estimates of Tukey contrasts from linear models fitted to decisions to wait for the light to turn green (rule compliance; LHS column). We observe that ambiguity strongly decreases rule-following (wait on green; LHS column). Conditional upon not having moved on red yet, the yellow light strongly increases the likelihood of moving between 9 and 12 seconds ('conditional yellow'; RHS). To test for interactions between ambiguity and peer behavior, we test differences in differences in treatments with peer behavior relative to the no-peer treatments. We observe that the observed interaction effects in the ANOVAs (Table 1A) stem from the treatments where the peer moved between 9 and 12 seconds (AY-AN vs NY-NN). The p-value of these interactions remain below the conventional level of 0.05 after correcting for multiple comparisons only for the 'conditional yellow' model (arguably the cleanest measure of the effect of the yellow light, as this model accounts for participants who already moved before the light turned yellow, and as such, did not experience the treatment). Note that the ANOVA from Table 1A detected no significant interaction effects of ambiguity and peer behavior for moving on red; the interaction effect for moving on green also exceeded the 0.05 threshold. As per our pre-registration, the specific interaction effects indicated here should be interpreted as exploratory results. For robustness tests of the models, see Table S3.

	green				red				conditional yellow			
	OLS		*logistic*		*OLS*		*logistic*		*OLS*		*logistic*	
NN (baseline)	0.583***	0.655***	0.336*	0.648**	0.377***	0.372***	-0.500***	-0.530*	0.063	-0.043	-2.700***	-3.422***
NR	-0.113*	-0.116*	-0.454*	-0.477*	0.142**	0.147**	0.579**	0.610**	-0.043	-0.042	-1.172	-1.191
NY	-0.189***	-0.187***	-0.767***	-0.768***	-0.023	-0.024	-0.098	-0.107	0.326***	0.322***	2.249***	2.231***
NG	0.053	0.043	0.221	0.185	-0.013	-0.002	-0.057	-0.01	-0.063	-0.064	-15.866	-15.876
AN	-0.190***	-0.194***	-0.772***	-0.800***	-0.005	-0.004	-0.021	-0.018	0.311***	0.316***	2.185***	2.222***
AR	-0.269***	-0.271***	-1.115***	-1.140***	0.181***	0.184***	0.735***	0.757***	0.224***	0.221***	1.791***	1.774***
AY	-0.209***	-0.207***	-0.850***	-0.854***	0.002	-0.001	0.008	-0.005	0.334***	0.332***	2.281***	2.285***
AG	-0.120*	-0.116*	-0.482*	-0.474*	0.024	0.02	0.099	0.087	0.163***	0.157**	1.468***	1.432***
age		-0.003**		-0.012**		0.001		0.006		0.003**		0.019**
gender: female		0.083***		0.354***		-0.097***		-0.411***		-0.011		-0.088
gender: other		0.148		0.628		-0.214*		-1.004*		0.045		0.331
Observations	1620	1601	1620	1601	1620	1601	1620	1601	947	940	947	940
R^2	0.042	0.053			0.022	0.034			0.149	0.157		
Adjusted R^2	0.038	0.047			0.017	0.028			0.143	0.148		
Log Likelihood			-1081.99	-1060.01			-1082.29	-1057.99			-411.548	-406.085
Akaike Inf. Crit.			2179.987	2142.02			2180.58	2137.989			839.095	834.17
Residual Std. Error	0.489 (df = 1612)	0.486 (df = 1590)			0.489 (df = 1612)	0.486 (df = 1590)			0.385 (df = 939)	0.385 (df = 929)		
F Statistic	10.097*** (df = 7; 1612)	8.962*** (df = 10; 1590)			5.083*** (df = 7; 1612)	5.566*** (df = 10; 1590)			23.522*** (df = 7; 939)	17.317*** (df = 10; 929)		

Table S3. Behavioral experiment: models fitted to each of the possible choices, including robustness tests. For each behavior we fitted linear and logistic models without and with controls. As pre-registered, the results presented in the main text are based on the simplest models (linear models without controls; leftmost columns for each behavior). Consistent with earlier work based on the traffic light paradigm (Gächter et al., 2023), in the absence of ambiguity, a peer moving on red or yellow significantly reduced compliance (NR and NY in the left hand side model), while a peer moving on green did not increase compliance (NG). We further observe that all main behavioral results are robust to alternative model specifications (this is also the case for robustness checks based on multinomial models, please see the analysis code via https://osf.io/fqmuk).The analyses reported in the table reveal that older participants tend to be slightly more likely to bend the rule, and men are substantially more likely to violate the rule (and move immediately upon reaching the red light). Results reported in the main text and in Table S2 are based on the OLS models without controls. For the model fitted to decisions to wait on green (OLS model on the left hand side), a confirmatory Bayesian hypothesis test conducted with the BFpack (Mulder et al., 2019) found more support for the order constraints NR=NY<NG=NN than for NR<NY<NG=NN (posterior probabilities: 0.020 and 0.978 for these two respective hypotheses; complement: 0.002). This suggests that in the absence of ambiguity, compliance was equally reduced by a peer violating the rule immediately, or after a time lag (i.e. moving on red right upon arrival, or after 9 seconds when the light was still red).

Normative rating of moving on red

contrast	estimate	SE	t	p
NR - NN	0.115	0.080	1.431	0.282
AR - AN	0.118	0.082	1.442	0.276

Normative rating of moving on yellow (or late on red)

contrast	estimate	SE	t	p
AN - NN	0.517	0.078	6.662	<0.001
NR - NN	-0.023	0.077	-0.299	0.998
NY - NN	0.015	0.078	0.190	1.000
AR - AN	-0.115	0.078	-1.459	0.472
AY - AN	-0.133	0.078	-1.705	0.319

Table S4. Injunctive norms: contrasts. Contrasts are based on the linear model without controls fitted to ratings of behavior shown in Table S5. We observe that a peer moving on red did not significantly increase ratings of the focal participant moving on red (although a test of ratings for red for pooled data of NN and AN against NR and AR showed a borderline significant increase; β=0.116, t=1.972, p=0.049). For normative evaluations of moving after 9 seconds, we observe a strong positive effect of ambiguity: social appropriateness of moving on yellow (in the AN treatment) was rated 0.517 higher than moving on red in the NN treatment (p<.001, remaining at that level after correction for multiple comparisons). Ratings of moving on yellow were not impacted by the behavior of peers (other contrasts), confirming the impression from the ANOVA reported in Table 1B of the main text.

	red		yellow		green	
NN (baseline)	1.592***	1.626***	1.970***	2.134***	3.746***	3.891***
NR	0.115	0.113	-0.023	-0.022	-0.136	-0.134
NY	0.171*	0.171*	0.015	0.025	-0.269***	-0.257**
NG	-0.004	0.000	-0.156*	-0.15	-0.094	-0.093
AN	0.000	-0.002	0.517***	0.529***	-0.104	-0.091
AR	0.118	0.116	0.403***	0.410***	-0.114	-0.105
AY	-0.077	-0.077	0.385***	0.386***	-0.066	-0.066
AG	-0.137	-0.139	0.325***	0.337***	0.054	0.066
age		-0.035		-0.062		0.001
gender: female		-0.248		-0.044		0.159
gender: other		-0.000		-0.004*		-0.004**
Observations	1605	1605	1606	1606	1606	1606
R^2	0.014	0.017	0.084	0.09	0.013	0.019
Adjusted R^2	0.01	0.01	0.08	0.084	0.009	0.013
Residual Std. Error	0.810 (df = 1597)	0.810 (df = 1594)	0.779 (df = 1598)	0.777 (df = 1595)	0.780 (df = 1598)	0.778 (df = 1595)
F Statistic	3.324** (df = 7; 1597)	2.684** (df = 10; 1594)	20.893*** (df = 7; 1598)	15.705*** (df = 10; 1595)	3.013** (df = 7; 1598)	3.101*** (df = 10; 1595)

Table S5. Injunctive norms: linear models with and without controls. Numbers reflect estimates from linear models fitted to appropriate ratings (in the range 1-4; see Methods). Results reported in the main text and in Table S4 are based on the OLS models without controls. Controlling for age and gender does not change any of the results of interest. See Table S6 for linear mixed models fitted to the same data, which account for dependencies in the data due to the fact that each participant in Study 2 (experiments on social norms) rated each of the three behaviors in this task. We observe that, against our preregistered prediction, a peer moving on red (NR treatment) did not lead to higher ratings for the focal moving on red. Ratings for moving on yellow (or late on red for the treatments without ambiguity) were only weakly affected by peer behavior, but very strongly by the presence of the yellow light (AN, AR, AY and AG treatments). Surprisingly, showing a peer moving late on red (NY) led to lower ratings for green.

	rating	rating
NN (baseline)	1.592***	1.735***
NR	0.116	0.117
NY	0.170*	0.178*
NG	-0.005	-0.0004
AN	-0.0001	0.007
AR	0.117	0.121
AY	-0.077	-0.077
AG	-0.137	-0.13
yellow	0.378***	0.378***
green	2.154***	2.154***
NR x yellow	-0.138	-0.138
NY x yellow	-0.156	-0.156
NG x yellow	-0.153	-0.153
AN x yellow	0.517***	0.517***
AR x yellow	0.285**	0.285**
AY x yellow	0.462***	0.462***
AG x yellow	0.462***	0.462***
NR x red	-0.250*	-0.250*
NY x red	-0.440***	-0.439***
NG x red	-0.091	-0.091
AN x red	-0.104	-0.104
AR x red	-0.232*	-0.232*
AY x red	0.011	0.011
AG x red	0.191	0.191
age		-0.003**
gender female		-0.030
gender other		-0.041
Observations	4,817	4,817
Log Likelihood	-5,729.76	-5,734.19
Akaike Inf. Crit.	11,511.52	11,526.38
Bayesian Inf. Crit.	11,680.00	11,714.30

Table S6. Injunctive norms. Numbers show results from linear mixed models fitted to all ratings, with 'participant' as random intercept. Model 1 (left-hand side) is a model without controls, and model 2 (right-hand side) includes controls for age and gender. The reference category in the models concerns ratings for 'red', for the treatment without peers and without ambiguity (NN). Most notably, ratings for yellow are only slightly higher than ratings for red (0.378 points on the 4-point scale; cf. Fig. 3A, B), and that ratings for yellow are higher (i.e. less disapproval) for the treatments with ambiguity (interaction effects AN, AR, AY and AG with yellow have strongly positive and significant estimates).

	green	red	conditional yellow
AN vs NN	-0.07 [-0.11,-0.02], p=0.015	0.02 [-0.01,0.06], p=0.540	0.06 [0.01,0.10], p=0.028
AR-AN vs NR-NN	0.04 [-0.03,0.10], p=0.569	0.01 [-0.04,0.06], p=0.976	-0.04 [-0.11,0.02], p=0.365
AY-AN vs NY-NN	0.08 [0.01,0.14], p=0.069	-0.06 [-0.11,-0.01], p=0.078	-0.04 [-0.10,0.02], p=0.428
AG-AN vs NG-NN	0.1 [0.03,0.16], p=0.009	-0.08 [-0.13,-0.03], p=0.009	-0.06 [-0.12,-0.00], p=0.113

Table S7. Descriptive norms: planned contrasts. Numbers show Tukey HSDs, with 95% confidence intervals in brackets and associated p values, for each of the three possible actions. Contrasts were based on a linear model without controls, presented in Table S8. Estimated frequencies of each behavior entered the regression as fractions (so, for example, -0.07 means a reduction of 7%). Conditional yellow indicates the fraction of participants moving on yellow, conditional upon not having moved yet on red (see Methods). Most notably, we observe that participants expect ambiguity to lower compliance (AN vs NN; green), due to an increase in moving on yellow.

treatment	green		red		conditional yellow	
NN (baseline)	0.562***	0.513***	0.215***	0.251***	0.306***	0.335***
NR	-0.079***	-0.079***	0.052**	0.052**	0.049*	0.049*
NY	-0.074**	-0.077**	-0.005	-0.003	0.089***	0.092***
NG	-0.024	-0.026	0.024	0.026	0.021	0.021
AN	-0.067**	-0.069**	0.022	0.024	0.057**	0.059**
AR	-0.108***	-0.110***	0.085***	0.086***	0.061**	0.062**
AY	-0.065**	-0.065**	-0.042*	-0.042*	0.105***	0.105***
AG	0.009	0.006	-0.034	-0.032	0.015	0.016
age		0.001**		-0.001		-0.001*
gender: female		0.009		-0.026**		0.009
gender: other		0.037		-0.046		-0.017
Observations	1,606	1,606	1,606	1,606	1,604	1,604
R^2	0.026	0.031	0.042	0.05	0.024	0.027
Adjusted R^2	0.022	0.025	0.038	0.044	0.019	0.021
Residual Std. Error	0.236 (df = 1598)	0.235 (df = 1595)	0.188 (df = 1598)	0.188 (df = 1595)	0.220 (df = 1596)	0.220 (df = 1593)
F Statistic	6.100*** (df = 7; 1598)	5.181*** (df = 10; 1595)	10.127*** (df = 7; 1598)	8.432*** (df = 10; 1595)	5.521*** (df = 7; 1596)	4.389*** (df = 10; 1593)

Table S8. Descriptive norms: linear models. Numbers indicate estimates from linear regressions fitted to expected frequencies of each behavior (green, red, and yellow conditional upon not having moved yet on red). For each behavior, we present a model without and a model with controls for age and gender. Results do not differ much between models. Note that this approach does not account for dependencies in the data stemming from the fact that participants' estimates for the three behaviors had to sum up to 100, and hence were not independent. Dirichlet regression predictions closely match those of these linear models, suggesting that our approach of fitting linear models to dependent data does not lead to substantial biases in the estimates.

4. Experimental materials

4.1 Experimental code

The experimental code can be accessed in editable form in LIONESS Lab. You can create a free account on lioness-lab.org. In the repository you can find the behavioral task of Study 1 under “Traffic light task – ambiguity” and the task measuring social norms of Study 2 under “Traffic light task - ambiguity - social norms” (both created by Lucas Molleman). For deploying the tasks, please refer to the documentation linked on lioness-lab.org.

4.2. Experimental screens shown to participants

Below we show screenshots of the behavioral task and the tasks measuring normative and descriptive beliefs as shown to participants. Clickable buttons are shown [between square brackets]. We separate different screens with a line of asterisks: **********

Where appropriate, we added comments to screens in grey boxes like this one.

4.2.1. BEHAVIOURAL TASK

Welcome!

Thank you for participating in our study.

This study consists of three parts. In each part you can earn points.
The total number of points you earn determines your bonus payment **(20 points = £1.00)**.

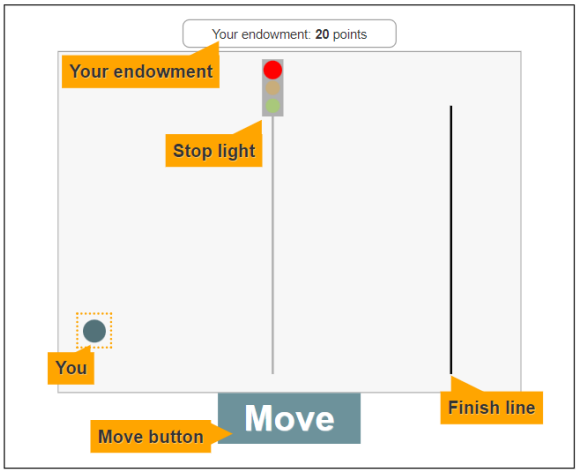
If you are using a desktop or laptop to complete this study,
we recommend that you maximize your browser screen before you start.

[Continue]

****

Instructions part 1 - screen 1 of 6

You control a circle figure that you have to move across the screen over the finish line.



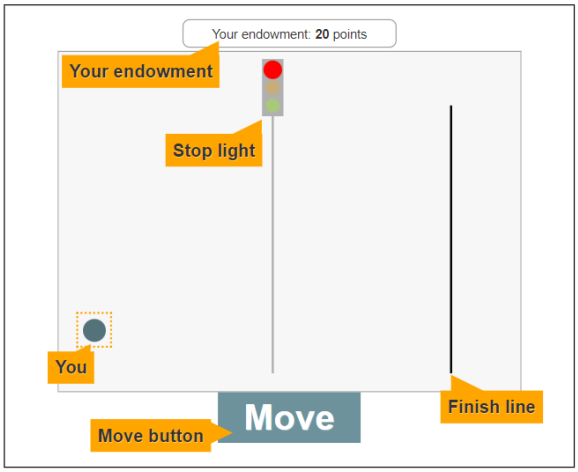
[Back] [Continue]

****

Instructions part 1 - screen 2 of 6

Once you click the **Move** button at the bottom of your screen, your circle will approach the stop light and will stop to wait.

To make your circle move again, again click the Move button.

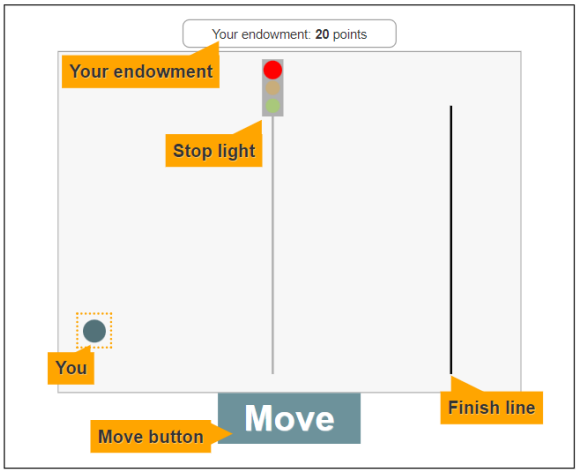


[Back] [Continue]

****

Instructions part 1 - screen 3 of 6

The rule is to wait at the stop light until it turns green.



[Back] [Continue]

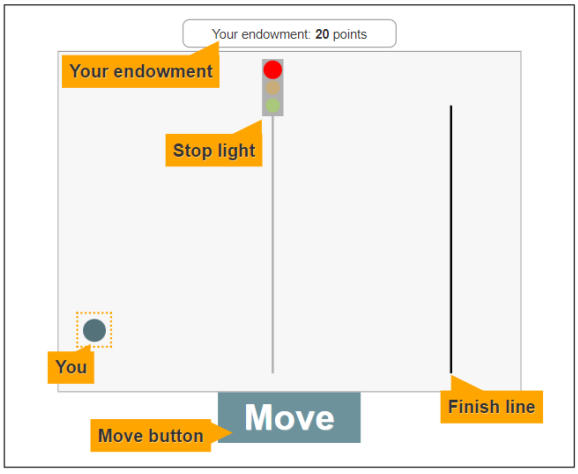
****

Instructions part 1 - screen 4 of 6

Your **earnings** in Part 1 are determined by the amount of time it takes you to move your circle across the finish line.

You begin with an endowment of 20 points.

Each second, this endowment will decrease by 1 point until you cross the finish line.



[Back] [Continue]

****

Instructions part 1 - screen 5 of 6

Below you can see how the task will look.

An animated gif of the task

[Back] [Continue]

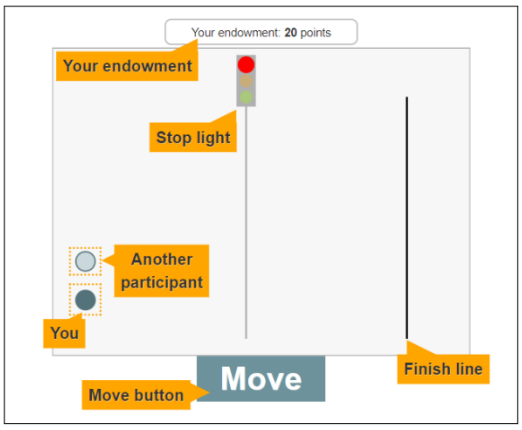
The GIF showing how the task would look when played on their own; for treatments with ambiguity, this included the light turning yellow; examples can be viewed via https://cmstudies.net/pics/nonambiguous-rule.gif (non-ambiguous situation) and https://cm-studies.net/pics/ambiguous-rule.gif (ambiguous situation)

****

Instructions part 1 - screen 6 of 6

In the task, your screen will also show a light blue circle.
This circle displays the movements of another participant.

When you click Continue, a brief quiz will check your understanding of the task.



[Back] [Continue]

****

Control questions

Your earnings in Part 1 are determined by the time it takes you to move your circle across the screen and over the finish line.
You begin with 20 points, and each second this decreases by 1 point until you cross the finish line.

Please answer the following questions.

1. Imagine that you wait to move across the screen until the stop light turns green. You finish the task in 15 seconds.

How many points would you earn?

2. Imagine that you move before the stop light turns green. You finish the task in 4 seconds.

How many points would you earn?

[Back to instructions] [Continue]

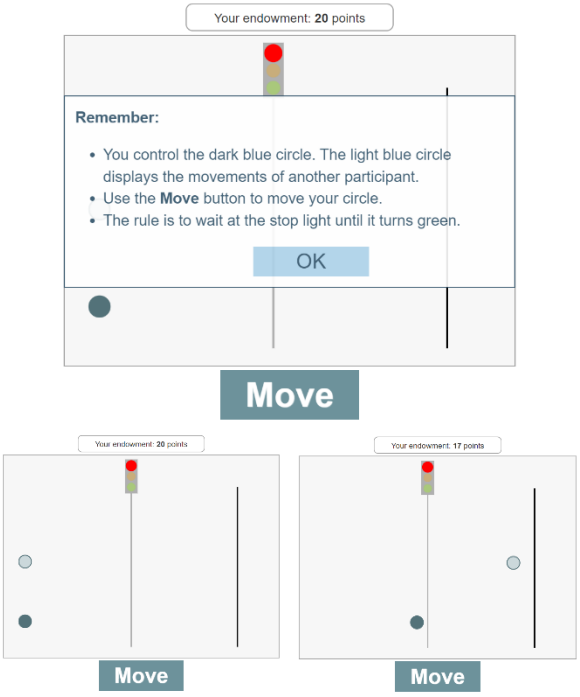
****

Ready to start

That is correct! Please click below to proceed to the task.

[Continue]

****



[submit]

The top screenshot shows the overlay reminder of the rule. Participants had to click OK before they could start their task. For tasks without peers, no light blue circle was shown. The reminder text in the overlay was identical, except that it did not read “The light blue circle displays the movements of another participant.”

The bottom two screenshots show two points in the task, in a treatment where the peer (light blue circle) had moved immediately upon reaching the stop light.

The submit button appeared once the participant's circle had crossed the finish line.

****

This is the end of part 1.

[Continue to part 2]

****

Part 2 of the study is identical to the norms study presented in section 4.2. Participants of the behavioural study also completed the task, but due to a programming error, they did not see the correct questions for rating the different behaviours as the situation they rated did not always correspond to the treatment they just completed, which likely caused confusion. In the paper, we therefore do not report the norms data from participants who also completed the behavioural task (which might have been influenced by the participants' choices in the behavioural task), but restrict ourselves to data from participants who did not complete the task.

****

Questionnaire - screen 1 of 1

Please fill out this brief questionnaire to finalize this study.

What is your gender?

[Male] [Female] [Other / prefer not to say]

What is your age?

Do you happen to have participated in a study similar to this one, in which you had to move your circle across the screen?

[Yes] [No]

****

Your earnings

Your guaranteed participation fee is: **£0.50**.

In part 1 of this study you earned 0 points.
Your bonus for part 1 is **£0.60**.

As soon as this study has completed,
we will calculate your bonus for part 2 and part 3,
and pay out your total bonus (parts 1 + 2 + 3).

To receive your earnings, please enter this code into Prolific:

---Prolific code---

After you have done that, you can close this window.
Thank you for participating in our study.

4.2.2. SOCIAL NORMS TASKS

Welcome!

Thank you for participating in our study.

In this study you can earn a **bonus** of **up to £1.00**.
Any bonus you earn comes on top of your **participation fee** of **£0.50**.

If you are using a desktop or laptop to complete this study,
we recommend that you maximize your browser screen before you start.

[Continue]
****

Instructions

In this study you will evaluate the actions of participants in a study we recently ran on Prolific.

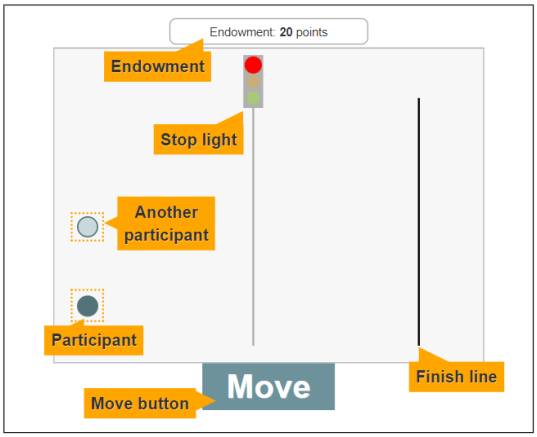
The next screen describes this previous study.
After that, you will evaluate the actions of the participants in that study.

[Back] [Continue]
****

Description of the previous study

The participants of our previous study controlled a dark blue circle figure that they had to move across their screen over a finish line.

Once they clicked the **Move** button at the bottom of their screen, their circle approached the stop light and stopped to wait.
To make their circle move across the screen and over the finish line, they again clicked the Move button.



The participants' earnings depended on the amount of time they took to move their circle across the finish line.
They began with an endowment of 20 points (20 points = £1). Each second, this endowment decreased by 1 point until they crossed the finish line.

Before completing their task, the participants were told: **The rule is to wait at the stop light until it turns green.**

After **9 seconds**, the stop light turned **yellow**. After **12 seconds**, it turned **green**.
During the task, the screen also displayed the **movements of another participant** (light blue circle).

The next screen will check whether you understand the task from the previous study.

[Back] [Continue]

****

Check for understanding

For this study it is important that you understand the task from the previous study.

To check that, please indicate whether the following statements are true or false.
Should you get any of these wrong, please go back to revisit the information about the task.

The faster the participants in our previous study completed their task, the more money they could earn.
[true] [false]

Before starting their task, participants in the previous study were told that the rule was to wait until the stop light turned green.
[true] [false]

In the previous study, participants would earn more when they moved immediately (when the stop light was still red) than when they waited for the light to turn green.
[true] [false]

[Back to the description of the previous task] [Continue]

****

Your task

Your task in the current study is to evaluate the behaviour of participants in our previous study.

You will do this in two brief parts.

[Continue]

The two parts measured normative and descriptive beliefs, respectively. Participants completed the tasks in randomized order.

****

Your task - part 1

Imagine a participant completing our previous study.
We refer to this person as "Person A".

We will describe different actions that Person A could take.
For each action, you must rate whether it is "socially appropriate" or "socially inappropriate".

By socially appropriate, we mean behavior that you think most people would agree it is the "correct" thing to do.
Another way to think about what we mean is that if someone were to behave in a socially inappropriate way,
then other people might be angry at them.

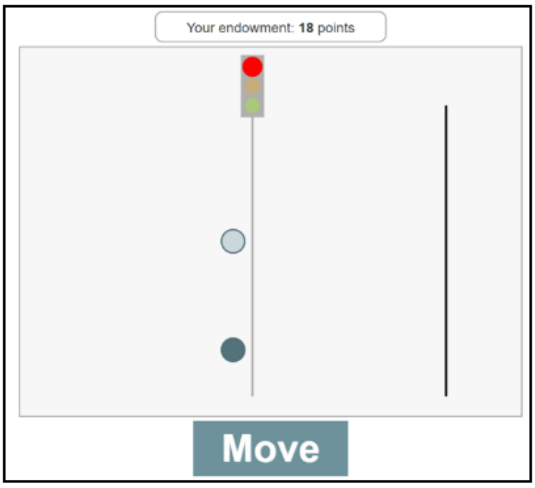
To determine **your bonus for this part**, we will randomly select one other participant in the current study.
(As this study is restricted to the USA, the other participant will also be from the USA.)

We will then randomly select one of the actions that Person A could take.
Your rating of this action will be compared with that of the other participant.
If your rating is the same as theirs, you will receive a bonus of £0.50.

[Continue]

****

Before starting the task, Person A was told: ***The rule is to wait at the stop light until it turns green.***
Now imagine Person A is in this situation.



They are 2 seconds into the task - their endowment has decreased from 20 to 18 points.
Their dark blue circle has approached the stop light and has stopped to wait.
The circle of the other participant has also stopped to wait.

After **9 seconds**, the stop light turns **yellow**. After **12 seconds**, it turns **green**.
The **other participant** (light blue circle) **moves after 9 seconds**, right after the stop light has turned **yellow**.

Please rate the following action by Person A.

1. Person A moves as soon as the stop light turns green.
Person A finishes in 15 seconds and earns 5 points.

[very socially inappropriate] [somewhat socially inappropriate] [somewhat socially appropriate][very socially appropriate]
(Remember: you can earn a bonus if your rating matches that of another participant in the current study.)
[Continue]

This screen included the following treatment variations:

The text in the **box** changes with the treatment:

- NN: After **12 seconds**, the stop light turns **green**.
- NR: After **12 seconds**, the stop light turns **green**. The **other participant** (light blue circle) **moved immediately** while the stop light was still **red**.
- NO: After **12 seconds**, the stop light turns **green**. The **other participant** (light blue circle) moves **after 9 seconds**, while the stop light is still **red**.
- NG: After **12 seconds**, the stop light turns **green**. The **other participant** (light blue circle) **moves after 12 seconds**, after the stop light has turned **green**.
- AN: After **9 seconds**, the stop light turns **yellow**. After **12 seconds**, it turns **green**.
- AR: After **9 seconds**, the stop light turns **yellow**. After **12 seconds**, it turns **green**.
- The **other participant** (light blue circle) **moves immediately** while the stop light is still **red**.
- AO: After **9 seconds**, the stop light turns **yellow**. After **12 seconds**, it turns **green**. The **other participant** (light blue circle) **moves after 9 seconds**, right after the stop light has turned **yellow**.

- AG: After **9 seconds**, the stop light turns **yellow**. After **12 seconds**, it turns **green**. The **other participant** (light blue circle) **moves after 12 seconds**, after the stop light has turned **green**.

For treatments without peers (NN and AN), the screenshot did not show a light blue circle representing the peer.

The text in bold for the ratings changes according to the rated behaviour:

- **Person A moves right away, while the stop light is still red. Person A finishes in 5 seconds and earns 15 points.**
- **Person A moves after 9 seconds, when the stop light is still red. Person A finishes in 11 seconds and earns 9 points.** [treatments without ambiguity]
- **Person A moves after 9 seconds, when the stop light turns yellow. Person A finishes in 11 seconds and earns 9 points.** [treatments with ambiguity]
- **Person A moves as soon as the stop light turns green. Person A finishes in 15 seconds and earns 5 points.**

The three behaviours that participants had to rate appeared on three separate screens. These screens were presented in randomized order.

****

This is the end of part 1.
[Continue to part 2]

****

Your task - part 2

In part 2, you have to make an estimation about the behavior of the participants in our previous study.

In the next screen, you will see various actions the participants could take.
You will estimate what actions they actually took.

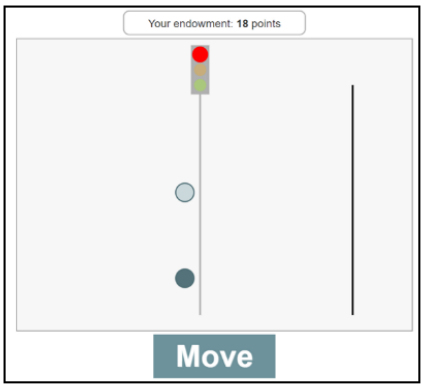
Whether or not you will be paid a **bonus of** for this part, depends on whether your estimates are **accurate**.
This works as follows:

After this study has completed, we will randomly select one of the actions.
If for that action, your estimate is no more than 5 percentage points off, you will receive a bonus of £0.50 points for this part.

[Continue]

****

Before completing their task, the participants were told: **The rule is to wait at the stop light until it turns green.**
Then their task started.



Two seconds into the task, their endowment decreased from 20 to 18 points.
Their dark blue circle approached the stop light and stopped to wait.
The circle of the other participant also stopped to wait.

After **9 seconds**, the stop light turned **yellow**. After **12 seconds**, it turned **green**.
The **other participant** (light blue circle) **moved after 9 seconds**, right after the stop light turned **yellow**.

Now estimate what actions the participants in our previous study took:

What percentage of previous participants moved *right away*, while the stop light was still **red**?
What percentage of previous participants moved *between 9 and 12 seconds*, when the stop light was **yellow**?
What percentage of previous participants moved *after 12 seconds* when the stop light had turned **green**?

(Remember: you can earn a bonus if your estimates are accurate.)

[Continue]

This screen included the same treatment variations as the screens eliciting normative beliefs.

The text in the **box** changes with the treatment:

- NN: After **12 seconds**, the stop light turns **green**.
- NR: After **12 seconds**, the stop light turns **green**. The **other participant** (light blue circle) **moved immediately** while the stop light was still **red**.
- NO: After **12 seconds**, the stop light turns **green**. The **other participant** (light blue circle) moves **after 9 seconds**, while the stop light is still **red**.
- NG: After **12 seconds**, the stop light turns **green**. The **other participant** (light blue circle) **moves after 12 seconds**, after the stop light has turned **green**.
- AN: After **9 seconds**, the stop light turns **yellow**. After **12 seconds**, it turns **green**.
- AR: After **9 seconds**, the stop light turns **yellow**. After **12 seconds**, it turns **green**.
- The **other participant** (light blue circle) **moves immediately** while the stop light is still **red**.
- AO: After **9 seconds**, the stop light turns **yellow**. After **12 seconds**, it turns **green**. The **other participant** (light blue circle) **moves after 9 seconds**, right after the stop light has turned **yellow**.
- AG: After **9 seconds**, the stop light turns **yellow**. After **12 seconds**, it turns **green**. The **other participant** (light blue circle) **moves after 12 seconds**, after the stop light has turned **green**.

For treatments without ambiguity, the second question read: “What percentage of previous participants moved *between 9 and 12 seconds*, when the stop light was still **red**?”

For ease of understanding, these three questions were stated in fixed order, on the same screen.

The total percentage entered by participants should sum up to 100. If it did not, the screen read: “The percentages need to sum up to exactly 100!”

This is the end of part 2.

[Continue to questionnaire]

****

Questionnaire

Please fill out this brief questionnaire to finalize this study.

What is your gender?

Male

Female

Other / prefer not to say

What is your age?

Do you happen to have participated in a study similar to the previous study described here, in which you had to move your circle across the screen?

[Yes] [No]

****

Your earnings

Your guaranteed participation fee is: **£0.50**.

As soon as this study has completed, we will calculate your **bonus** for parts 1 and 2, and pay it out.

To receive your earnings, please enter this completion code into Prolific:

---Prolific code---

After you have done that, you can close this window.
Thank you for participating in our study.

Economics Working Papers

2022-04	Hans Schytte Sigaard: Labor Supply Responsiveness to Tax Reforms
2022-05	Edi Karni and Marie-Louise Vierø: Comparative Incompleteness: Measurement, Behavioral Manifestations and Elicitation
2022-06	Marie-Louise Vierø: Lost in objective translation: Awareness of unawareness when unknowns are not simply unknowns
2022-07	Daniele Nosenzo, Erte Xiao and Nina Xue: Norm-Signalling Punishment
2023-01	Susanna Loeb, Michala Iben Riis-Vestergaard and Marianne Simonsen: Supporting Language Development through a Texting Program: Initial Results from Denmark
2023-02	Sumon Bhaumik, Subhasish M. Chowdhury, Ralitza Dimova and Hanna Fromell: Identity, Communication, and Conflict: An Experiment
2023-03	Changli He, Jian Kang, Annastiina Silvennoinen and Timo Teräsvirta: Long Monthly European Temperature Series and the North Atlantic Oscillation
2023-04	Jos Jansen: Share to Scare: Technology Sharing in the Absence of Strong Intellectual Property Rights
2023-05	Peter Rønø Thingholm: Provider Spill-Overs in Opioid Prescription Leniency and Patient – Labor Market Outcomes
2023-06	Alexander K. Koch, Dan Mønster and Julia Nafziger: Nudging in complex environments
2023-07	Svend Hylleberg: Oeconstudiet og den økonomiske faggruppe ved Aarhus Universitet fra 1936 til 1965
2023-08	Arnaud Dupuy, John Kennes and Ran Sun Lyng: Job Amenities in the Market for CEOs
2023-09	Scott Condie, Lars Stentoft and Marie-Louise Vierø: Unawareness Premia
2023-10	Johannes Schünemann, Holger Strulik and Timo Trimborn: Anticipation of Future Consumption, Excessive Savings, and Long-Run Growth
2023-11	Lucas Molleman, Daniele Nosenzo and Tina Venema: Ambiguity induces opportunistic rule breaking and erodes social norms