Compliance Externalities And The Role Model Effect on Law Abidance: Field and Survey-experimental Evidence[*]

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Abstract: Recent theories of compliance predict that, apart from utilitarian considerations, individual decisions to respect or break the law account for virtuous motives and non-utilitarian willingness to promote the social good. We test whether empirical evidence supports these theories by collecting data on cyclists' decisions to ignore a red traffic light in a natural setting. We consider different situations where non-compliance is costly, but without risk, and where material deterrence incentives from legal sanctions remain constant. The only difference between the situations lies in who is observing the cyclists' decision at the traffic light at the intersection of a footpath with the cycle track. We find that about 68% of cyclists ignore the red traffic light when there is the opportunity to do so. This frequency does not change substantially when adult bystanders are observing at the pedestrian traffic light. Interestingly, the violation frequency drops to about 10% when children are present. Robustness checks rule out the alternative explanations that this change is driven by concerns for children's unpredictable actions, or by the simultaneous presence of other adult bystanders. In a vignette study, we additionally dissect the cyclists' motives for being compliant. Results suggest a "role-model effect" on compliance. When asked, the majority of participants report that the willingness to educate and be a good example is the most important reason for their decision to abide by the law, hence supporting the empirical observation that promoting the social good can be an important non-utilitarian motive of compliance decisions.

Keywords: Behavioral Law and Economics, Social Norms, Social Welfare, Virtuous Motives

JEL Classification: K10, K42

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1 Introduction

Understanding the reasons why people comply with the law is a task of primary importance for legal scholars and policy-makers. This paper contributes to examining the behavioral determinants of compliance decisions. We investigate the idea that, apart from self-interested utilitarian considerations, advancing the social good can be an important reason for law-abiding behavior. Specifically, we empirically validate the hypothesis put forward by legal scholars that a person's desire to act as a role model affects the willingness to comply with the law. When facing a compliance decision, a role model takes into account "compliance externalities", i.e., the effect of witnessing one's compliance behavior on the observer's compliance decision. To test this hypothesis, we collect field data to see whether the role model hypothesis accounts for real-world observations and we additionally conduct a vignette experiment to shed light on the underlying motivations for rule compliance.

The economic theory of law has a long-standing tradition in understanding deterrence and compliance decisions, relying most famously on Becker's (1968) seminal contribution. The deterrence hypothesis rests on the traditional economic approach: private costs and benefits determine the compliance decision. In contrast to this rigorous approach, recent research expanded the framework and started investigating how elements beyond the strict economic paradigm influence compliance.[1] Broadening the analytical framework of deterrence research has sparked research about how private incentives interact with other aspects of compliance behavior such as social norms (Posner, 1997; Jolls et al. 1998), culture (Fisman and Miguel, 2007), crowding-out of deterrence incentives (Heyman and Ariely, 2004), morality (Zamir and Medina, 2008; Stringham, 2011; Ulen, 2015), self-serving and impulsive tendencies (Nagin and Pogarsky, 2003), and emotions (Khadjavi, 2015).

Despite this recent interest, compliance externalities remain under-studied. A noteworthy exception is the contribution of Shavell (2012). The author elaborates a model of compliance in which an individual's decision depends on canonical self-interested utilitarian considerations, and the information available to agents, as well as on the "indirect effects" of the decision on others. In particular, Shavell (2012) speculates that the decision to comply is influenced by a moral tutelary concern: the witnessing of compliance behavior determines a change in the desire of observers to comply or not comply with the law. Therefore, if a person has to decide whether to abide by the law and is observed by others and if that person thinks that the observer witnessing her compliance decision can alter the observer's tendency to abide by the rules, the likelihood to comply will be affected. To date, this hypothesis has not been empirically explored.

Our study contributes to the literature investigating the determinants of compliance by providing empirical evidence that supports Shavell's proposition. The compliance decision in our study regards the very general traffic rule and commonly known obligation to stop at a red traffic light. Our idea is that if a person's decision whether to ignore the red traffic light is influenced by the willingness to set a good example and so positively affects others' behavior, she will abide by the law more often when the effects of the decision are greater. The effect of setting a good example is the greatest on children, since their behavior is more malleable and they are more susceptible to the educational inputs received (Buchsbaum et

[1] The idea that the well-being of others is a key determinant in compliance decisions has already been advanced by classical philosophers and legal theorists. For instance, in Plato's *Crito*, Socrates, after being condemned to the death penalty, refuses his interlocutor's offer to let him escape from Athens because of his concerns for the city's well-being: "Do you think it possible for a city not to be destroyed if the verdicts of its courts have no force but are nullified and set at naught by private individuals?" (Plato, 2000, p. 54). In more recent years, arguments for respecting rules and obligations that are based on social welfare considerations have been advanced by Sartorius (1975) and Hare (1976).

al., 2011; Butler and Markman, 2014). Compared to adults, children may also be less able to draw sophisticated inferences from observed compliance behavior. Therefore, if a person desires to act as a role model in order to reduce negative compliance externalities, she will more often abide by the law in the presence of children.

We investigate this idea in two steps. First, we collect data on how often cyclists go through a red traffic light while simultaneously monitoring whether children are present and also keeping track of other circumstances in the environment surrounding the cyclists' decision. We find that, in general, the frequency with which the average cyclist ignores a red light is about 68%. The presence of just adults has a negative, small, and marginally significant effect on the frequency of traffic rule violations. In contrast, the frequency of cyclists not abiding by the traffic rules and ignoring the red light drops sharply to about 10% as soon as a child is simultaneously present at the traffic light.

Second, we conduct a between-subjects vignette experiment to verify whether the motives underlying the cyclists' decision confirm the role model hypothesis. In the vignette experiment, participants are confronted with a scenario that captures the essentials of our field setting. All scenarios ask the participant to imagine cycling on a bike path and approaching a red traffic light that regulates the crossing of cyclists and pedestrians at a crossroads. Scenario descriptions only differ in who is simultaneously present at the traffic light: (1) nobody else; (2) some adults; (3) some children; (4) some adults and children; or (5) parents and their children. We find the same main effect in the vignette study that we found in the field. When the scenario only describes the presence of adults the frequency of rule violation drops only a little. By contrast, in those scenarios that describe the presence of children the frequency of rule-violating choices drops sharply. After making their compliance decision, participants assessed the importance of six possible motives underlying their decision. Among compliant participants, only one motive was sensitive to the scenario manipulations: participants reported a significantly higher desire to act as a role model when the scenario described the presence of children. Concerns about legal or social sanctions, the desire to conform to other persons' behavior, safety concerns, or a Kantian motive for rule-compliance were unaffected by the manipulations.

The paper proceeds as follows. Section 2 reports on the data collection in the field and the design of the vignette study. Section 3 provides the analysis of the data from both the field and the vignette experiment. Section 4 discusses these results and concludes.

2 Data

2.1 Field data

Between May and June 2015, we manually collected data at two locations in Hamburg, Germany: (1) Friedrichstraße and (2) Fruchtallee. In each of these two locations, there is a junction where a cycle path crosses a public road at right angles. The locations are in a densely populated area close to the city center and the two cycle paths are used daily by thousands of cyclists.[2] While our observations in Friedrichstraße concern the crossing of a two-way street, our observations in Fruchtallee pertain to a one-way section of the street. We control for the difference in locations in our analysis, as crossing at the latter location is arguably less risky.

[2] The Appendix includes a map with the exact coordinates.

During data collection, the data collectors were sitting on the bench of a bus stop at Friedrichstraße and on a bench in the courtyard of a school at Fruchtallee. They had a book open in front of them. The spreadsheet to record observations was placed inside the book. The data collectors recorded whether cyclists complied with the red traffic light when (1) the cyclists were traveling on the bike path, (2) the cyclists confronted a red traffic light (while the traffic lights for cars were green), and (3) the cyclists had to cross the road. In this situation, cyclists can either abide by the traffic regulation and stop at the red traffic light, which entails opportunity costs of time to wait for their traffic light to change to green, or decide to break the law and cross the road despite the red signal.

In order to code an observation as "compliant", our protocol required that the four following conditions should hold simultaneously:

(1a) A cyclist arrives at the crossing approaching from the bike path and stops. Observations, when a cyclist did not approach from the bike path, were not recorded.

(2a) The traffic light for cyclists is red and the traffic light regulating car traffic on the perpendicular road is green. This signal combination is our window of observation. Note that in accordance with German traffic regulations (§ 37 StVO), both car and bike traffic lights at the two locations have a red ("stop!"), yellow ("attention!"), and green ("move!") signal and are synchronized such that five different combinations of signals (cars-bikes) can occur: (a) red-red; (b) red-yellow; (c) red-green; (d) yellow-red; (e) green-red. We only collected observations when combination (e) was signaled, because combination (e) entails no ambiguity as to which traffic party is entitled to move (cars) and which has to stop (cyclists).

(3a) When signal combination (e) occurs, the road is clear from cars, buses, motorbikes, or any other vehicle for at least seven seconds. Like the other conditions, this constraint aims at establishing comparability between observations.[3]

(4a) The cyclist does not cross the road until the bike traffic light becomes green.

In the same way, in order to code an observation as "non-compliant", our protocol relied on the following two variations of (2a) and (4a):

(2b) Signal combination (e) regulates traffic for at least three seconds. This condition was intended to ensure that cyclists are aware that they are in a clear violation scenario, i.e., the crossing is regulated by signal combination (e) rather than (a) or (d).

(4b) The cyclist crosses the road while the bike traffic light is still red *and* the car traffic light is still green, i.e., while signal combination (e) occurs. Again, ambiguous

[3] We choose the very conservative threshold of seven seconds in order to avoid possible mistakes in coding a cyclist's behavior as "compliant". For instance, if a shorter time threshold was used, we could have wrongly coded as compliant behavior the cyclist's failure to cross the red light due to her risk estimation for crossing the road when there is approaching traffic. Seven seconds is a time frame, in which arguably even an extremely risk-averse individual would find it safe to cross a one-way road. Therefore, we believe, our data rule out this possible confound.

situations (for instance, when the traffic light for cars changes to the yellow signal while the traffic light for cyclists still signals red) are not recorded.

During each iteration of the green-red signal combination we recorded at most one observation. If more than one cyclist approached the crossing during any window of observation, the behavior of only the first cyclist was recorded. Moreover, if multiple cyclists were compliant and non-compliant simultaneously, we dropped the observation. We also suspended data collection when other confounding factors were at work, namely: (1) when a cyclist was riding and talking on her mobile phone at the same time; (2) when we heard sirens of emergency vehicles, e.g., police, firefighters, or ambulances; and (3) when people got on or off a bus at Friedrichstraße in the proximity of the crossing.

For each resulting observation, we recorded the following additional information about the cyclists: the location; date and time; the cyclist's gender. The data collection also comprised an estimate of the data collectors about whether the cyclist was older than 50 years. In the same manner, we recorded whether the cyclists were Caucasian.

Moreover, we recorded additional information about the situational context. We recorded whether adult bystanders and/or children were present who could observe the cyclist's compliance decision.[4] We defined "children" as persons with an estimated body height of less than 120cm. Taller persons were classified as "adult" bystanders. In order to facilitate this classification for those persons close to the threshold height, we attached a red poster advertising a concert to the traffic lights at the crossing such that the poster's lower edge lay exactly at 120cm. When we classified a person as child, we additionally recorded whether the child was on the same or the opposite side of the street as the cyclist and whether the child was alone or accompanied by an adult. In the latter case, we also recorded whether the child was able to walk alone as opposed to being carried on a stroller, in a child's bike seat, or in the adult's arms.

Two persons collected data during multiple workdays and at different hours of the day between 7:00 and 20:00. Observations were recorded by both data collectors working contemporaneously in the same location but independently in 6 one-hour sessions during the first day of fieldwork. The protocol for validating data collected jointly was as follows. First, each person records, for each observation, the cyclist's compliance decision and situational factors. Each individual observation is precisely identified by the exact time it was collected. Second, at some regular time intervals the data collectors compare their observations. Third, for each observation, only entries regarding compliance decisions and situational factors that match in the two data sets are kept. Non-matching entries are coded as missing values. During the data collection sessions in which data collectors worked in parallel, they collected 83 observations each. A comparison of the two sets of data collected independently showed that the entries recording whether children were observing and whether a cyclist's behavior was compliant or non-compliant (our main variables of interest) perfectly matched for each of these 83 records across the two data collectors.[5] In 11 records, the entries recorded by the data collectors did not match regarding situational factors or cyclists' observable characteristics (9 of these 11 mis-matches were registered during the first one-hour data

[4] The data collectors were not asked to speculate whether the children were in fact observing the cyclist or whether they were looking in the cyclist's direction. They were asked to record whether the children were present and had the physical possibility to observe the cyclist's compliance decision (i.e., an infant for whom it is physically impossible to see the street because she is lying in an enclosed stroller pushed by an adult, was not recorded as a "child present".

[5] This result was expected, considering that the procedures to establish whether children are present and whether a cyclist is compliant are very detailed and specifically designed to minimize the possibility of mis-interpretation.

collection session). As mentioned above, disagreements were resolved by recording as missing values the entries that did not match. In subsequent data collection sessions, a single person working independently collected the data. A χ^2-test comparing the compliance rates observed in the sample of data collected by a single data collector against the one observed in the sample of data collected by the two data collectors working in parallel suggest no systematic differences between results obtained using the two procedures (when children are present, $\chi^2 = 0.002, p = 0.96$; when no child is present, $\chi^2 = 0.08, p = 0.78$).

We gathered a total of 445 observations, 79 of which involved cyclists' compliance decisions in the presence of children.

2.2 Vignette data

We conducted an additional vignette experiment to gather information of the kind we could not record in the field. The vignette experiment consisted of a main and a supplementary part. In the main part of the vignette study, the different scenarios in our treatments cover situations similar to those we observed in the field. Translated from German, the description in the baseline scenario was as follows:

> *While you are riding your bike on a bike path through the park, you approach a perpendicular road. You have to cross the road to continue riding on the bike path and arrive at your destination. The crossing of bike path and street is regulated by traffic lights. The traffic lights for pedestrians and cyclists have just changed to red and the traffic lights for road traffic already show green.*
>
> *Your view of both directions of the street is not obstructed. Neither cars nor other vehicles are close to the crossing. [There are no other people at the pedestrian traffic light.] You have a good overview of the surroundings and are absolutely certain that no policemen are observing you.*
>
> *Do you cross the street, although the traffic lights for pedestrians and cyclists are still red? Or do you wait until your traffic light changes to green?*

Only the bracketed sentence changed across the different scenario descriptions. Instead of the bracketed sentence in the baseline scenario ("Alone"), the other four scenarios each included one of the following sentences:

> *At the traffic light on the other side of the road, there are a few pedestrians who are looking in your direction.* ("Adult")
>
> *At the traffic light on the other side of the road, there are a few children who are looking in your direction.* ("Child")
>
> *At the traffic light on the other side of the road, there are two children and two other adults who are looking in your direction.* ("Child & Adult")
>
> *At the traffic light on the other side of the road, there are two children and their parents who are looking in your direction.* ("Child & Parents")

To make each scenario more salient, we supported the textual description with a drawing that matched each scenario.[6] The vignette experiment was run between-subjects, i.e., each participant was exposed to only one scenario. Participants were randomly assigned to the scenario.

In each scenario participants decided to either cross the road immediately or to wait for the traffic light to change to green, and then the second stage of the main part asked compliant participants to indicate the motives behind the preceding decision. We elicited six motives:

(1) concern about a legal sanction (*"Even though I am absolutely sure that there are no police in sight, I am concerned about being fined. One can never be sure."*);

(2) Kantian concern (*"Crossing the street is forbidden while the traffic light is red. A rule is a rule."*);

(3) concern about a social sanction (*"I don't want my fellow men yelling at me about crossing with the traffic light at red."*);

(4) social influence effect (*"When other people wait at the red light, I am willing to conform too, even if it is not dangerous to cross."*);

(5) role-model effect (*"I am concerned about how my fellow men perceive me. I don't want to be a bad example."*);[7]

(6) safety concern (*"I am concerned that other people move unpredictably and might endanger my crossing the street."*).

For each of these six motives, participants could indicate its weight for their compliance decision by adjusting the position of a slider between 0 and 100. In addition, we added an open-ended question about which other motives determined the participant's decision.

The remaining part of the vignette experiment was independent from the random scenario assignment and, thus, identical for all participants. This part aimed at gathering individual characteristics that may determine the compliance decision. We elicited participants' domain-specific risk attitudes by employing the respective questions from the German socio-demographic panel (SOEP). The seven risk domains covered are "general", "car driving", "financial matters", "sports and leisure", "career", "health", and "trust" (cf.: Dohmen et al., 2011). For each category, participants could report their risk attitude on a seven point Likert-scale between "not at all willing to take risks" and "very much willing to take risks". Likert-scales were coded from -3 to 3. A section concerning basic socio-demographic characteristics completed the supplementary part of the vignette experiment.

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[6] The Appendix shows all supporting drawings.

[7] As correctly pointed out by an anonymous referee, item 5 contains two possible motivations for compliance with the law: the willingness to act as a role-model (a pro-social motive) and also the willingness to produce a good impression on others (a more self-interested motive). We acknowledge that both motivations are present in item 5, so that this item formulation would not be ideal to measure the self-reported importance of acting as a good example. Nevertheless, we also emphasize that the results obtained remain valid since, as we will explain in detail in the next section, our analysis does not focus on the self-reported assessment of the importance of the role-model effect, but on how the presence of children – that is experimentally varied across scenarios otherwise identical – moderates the importance given to this motivation.

We programmed the vignette experiment in oTree (Chen et al., 2016).[8] During March 2016, we administered the study online through a server of the Max Planck Institute for Research on Collective Goods. We recruited participants as follows. In Germany, there are "Nett-Werk" groups (which is a wordplay on the German translation for "network") on social network platforms for any given bigger city (like Berlin, Cologne, Hamburg, etc.). These groups are open and feature up to tens of thousands members. The purpose of these groups is to provide support for each other for any kind of requests. We advertised the vignette study in "Nett-Werk" groups of major German cities. We invited users to participate in an online questionnaire and we provided a link that redirected the participant to the oTree server. After completing the registration, each participant was then randomly assigned to one of the five scenarios. Altogether, we sampled 309 participants from German-speaking countries.[9]

3 Analysis & results

3.1 Hypotheses

According to the role model hypothesis, the willingness to advance the social good by setting a good example is an important reason for abiding by the law. In the setting of this paper, the presence of children who observe a cyclist's decision to cross the red traffic light influences the compliance rate, since the cyclist wants to act as a role model and children are the most receptive to educational inputs.

We therefore derive two hypotheses:

1. All things being equal, cyclists' frequency of rule violation (both observed in the field data, and self-reported in the vignette experiment) is lower when there are children observing the compliance decision.

2. The weight that compliant respondents in the vignette experiment assign to the role-model motive (motive number 5 above) is larger in the scenarios in which children are present and observe the compliance decision.

3.2 Analysis of the field data

We begin our analysis by comparing the observable characteristics of the group of cyclists taking the decision to ignore the red traffic light when children were present against the characteristics of those cyclists whose decisions were recorded when no child was observing. The results summarized in Table 1 show no statistically significant differences on observables between the two groups. We then look at the frequency of cyclists violating the traffic rules, contingent on the presence at the traffic light of children, who are observing the non-compliant behavior. Figure 1a depicts the frequencies for both cases. While 67.94% of cyclists ignored their red traffic light and in contravention of rules crossed the street when children were not present, only 10.39% did so when children were present. A χ^2-test allows us to reject the null hypothesis that observed traffic rule violations and the presence of children are independent from each other ($\chi^2 = 84.202, p < 0.001$).

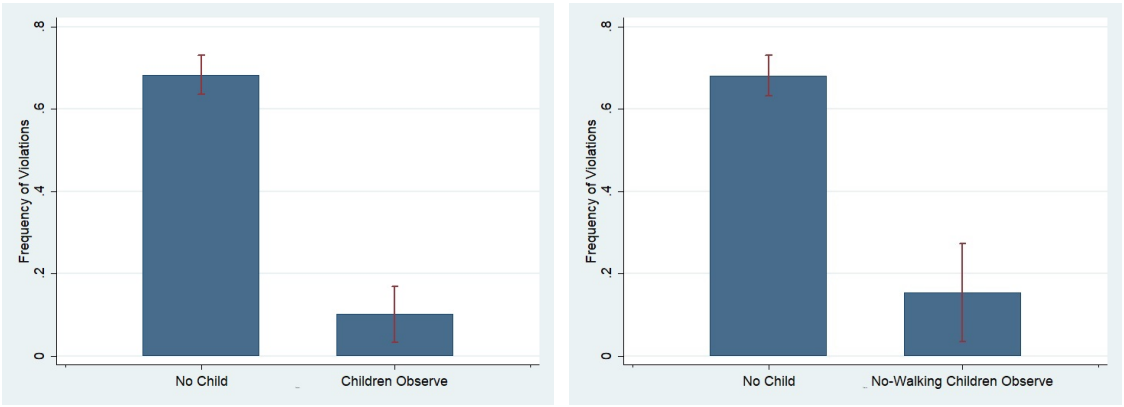
[8] The program in German is available upon request.
[9] While the majority of participants were German, we also had some Swiss and Austrian respondents.

Table 1: Cyclists' observable characteristics when (no) children are present

	Frequencies by Condition		
	Children Present	No-children	Diff (Pearson χ^2)
male	0.50	0.54	0.58
caucasian	0.92	0.94	0.59
old	0.38	0.39	0.83

Note: Comparison of cyclists' observable characteristics for whom compliance decisions were recorded in situations with children present or without children present, for the variables "old" ($n = 445$), "caucasian" ($n = 445$), and "male" ($n = 335$). The right column reports p-values from a Pearson χ^2-test.

Figure 1: Compliance Behavior in Presence of Children



(a) All Children **(b)** Restrained Children

Note: The figure reports the frequency of traffic rule violation when children are present or not. The panel includes the whole sample of observations. The right panel includes only observations where children cannot walk independently.

In a regression analysis, we control for other situational variables by estimating the effect of children being present on the frequency of non-compliant behavior. All the results presented below are estimated with hour-of-the-day fixed effects. Table 2 reports the results of estimations with both linear probability models (models 1 and 2) and logistic regression models (models 3 and 4). The dependent variable "cross" is a dummy taking value 1 when a cyclist does not comply with the law and crosses the red traffic light. The dummy variable "children" takes value 1 when a child was present at the traffic light and could observe the cyclist's compliance decision. The dummy variables "old" and "female" refer to observable characteristics of the cyclists (compare Section 2.1). Moreover, we control for time with variables "morning" and "peak", which indicate that the observation was collected before 12:00 noon and during peak traffic hours (7:30 a.m. - 9:00 a.m., 5.30 p.m. - 7:00 p.m.), respectively. Finally, the dummy variable "Friedrich" indicates whether the observation was collected at location Friedrichstraße. We estimated robust standard errors.

Table 2: Probability of Traffic Rule Violations

	Model 1	Model 2	Model 3	Model 4

children	-0.544***	-0.540***	-0.533***	-0.537***
	(0.052)	(0.063)	(0.062)	(0.084)
other bystanders	-0.065	-0.062	-0.064	-0.055
	(0.046)	(0.051)	(0.042)	(0.048)
old		-0.254***		-0.226***
		(0.052)		(0.041)
morning		0.241*		0.480***
		(0.131)		(0.131)
peak		-0.056		-0.244**
		(0.116)		(0.098)
Friedrich		-0.120		-0.132
		(0.084)		(0.083)
female		-0.116**		-0.111**
		(0.048)		(0.047)
(Constant)	0.960***	0.971***		
	(0.097)	(0.073)		
Hour fixed effects	yes	yes	yes	yes
Day fixed effects	yes	yes	yes	yes
N	445	335	445	335

Note: Dependent variable: dummy "cross" equal to 1 when cyclist violates the traffic rule. Models 1 and 2 report OLS regressions, Models 3 and 4 Logit regressions, with hour of the day and day fixed effects. Robust standard errors are calculated. Models 2 and 4 include controls for observables. Symbols ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

The results confirm that the presence of children has a strong and significant ($p < 0.01$) negative effect on the probability that a cyclist will go through the traffic light on red.[10] This result holds for any model specification, whether we include controls or not.[11]

A possibly confounding factor for the identification of a role-model effect may be that cyclists become much more careful when a child is around because they fear that an incautious child might behave and move in an unexpected manner. If the cyclists are concerned about children behaving unpredictably, their sensitivity towards the children's presence at the traffic light would be caused for reasons other than being a role model.[12] We avoid this concern by looking at the presence of only those children who are kept under the physical control of an adult, i.e., they are not walking independently. Rather, these children are carried in a stroller, in a child's bike seat, or in the adult's arms. Therefore, these

[10] We also collected the dummy variable "front" that controls for the child being at the opposite side of the road, the dummy variable "adults" that registers whether at least one adult is present, and the dummy "caucasian" that refers to the cyclists' race. In a more refined regression model, we included the dummy "caucasian" and we estimated whether compliance varies between situations where children are waiting alone at the traffic light or an adult accompanies them. The estimated increase in compliance is not statistically different in the two situations (results available upon request).

[11] Note that we lose 110 observations once we include all controls. The majority of this loss of observations is due to the inability to record a per se observable characteristic because the cyclist crossed the street very quickly. Moreover, in a few cases the characteristic was not coded alike when the data collectors worked contemporaneously in the same location. When observations conflicted, we coded the characteristic as missing value.

[12] We are grateful to Marco Casari, Ben Depoorter, and Luigi Franzoni for suggesting this alternative explanation.

restrained children are unable to engage in unexpected, dangerous actions that cyclists may be concerned about.

Table 3: Probability of Traffic Rule Violations – Children not Walking Independently

	Model 1	Model 2	Model 3	Model 4
children	-0.490***	-0.505***	-0.479***	-0.496***
	(0.072)	(0.082)	(0.085)	(0.113)
other bystanders	-0.071	-0.054	-0.069	-0.053
	(0.052)	(0.055)	(0.048)	(0.051)
old		-0.261***		-0.235***
		(0.055)		(0.043)
morning		0.438***		0.492***
		(0.122)		(0.138)
peak		-0.252**		-0.240***
		(0.110)		(0.106)
Friedrich		-0.123		-0.136
		(0.090)		(0.090)
female		-0.111**		-0.110**
		(0.050)		(0.050)
(Constant)	0.990***	0.970***		
	(0.120)	(0.076)		
Hour fixed effects	yes	yes	yes	yes
Day fixed effects	yes	yes	yes	yes
N	378	315	378	315

Note: Dependent variable: dummy "cross" equal to 1 when cyclist violates the traffic rule. The sample includes only observations where children are not walking independently, but are somehow restrained. Models 1 and 2 report OLS regressions, Models 3 and 4 Logit regressions, with hour of the day and day fixed effects. Robust standard errors are calculated. Models 2 and 4 include controls for observables. Symbols ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

Figure 1b illustrates the frequencies of compliance decisions contingent on children being present, but excluding those observations where children were walking independently. The pattern remains nearly unchanged. While 68.31% of cyclists ignored the red light when children were not present, only 14.58% did so when restrained children were present. Again, based on a χ^2-test we reject the null hypothesis that observed traffic right violations and the presence of children are independent from each other ($\chi^2 = 49.767, p < 0.001$). As before, we control for other situational variables. Correspondingly, Table 3 reports the results of estimations with both linear probability models (models 1 and 2) and logistic regression models (models 3 and 4). For any model specification, the results confirm that the presence of children, even when restrained, has a strong and significant ($p < 0.01$) negative effect on the probability that a cyclist ignores the red traffic light.[13]

[13] As suggested by an anonymous referee, another way to rule out this confounding factor is to examine what happens when only children are present, who are on the other side of the street at the moment when the cyclists are making their decision to comply or not. In these situations, the danger, which children might present by

A second possibly confounding factor might be audience size. Indeed, it is possible that children tend to assemble at traffic lights at particular time of the day when many other people are also waiting to cross the street. Should that be the case, it is possible that cyclists become more cautious in crossing the red traffic light because of the crowd waiting there, irrespective of the bystanders being children. To rule out this possibly confounding factor, in Table 4 we replicate the same regression reported in Table 2 excluding all the observations where, apart from children and eventually the person accompanying them, other bystanders are present at the traffic intersection.[14] Once again, results remain qualitatively the same and the point estimates are also very similar to those reported in Tables 2 and 3, suggesting that the observed increase in compliance is not driven by audience size effects.

Table 4: Probability of Traffic Rule Violations – No Bystander Except for Children and their Accompanying Person

	Model 1	Model 2	Model 3	Model 4
children	-0.550***	-0.556***	-0.504***	-0.498***
	(0.089)	(0.098)	(0.087)	(0.100)
old		-0.288***		-0.256***
		(0.069)		(0.051)
morning		0.119		0.268
		(0.160)		(0.171)
peak		-0.034		-0.139
		(0.153)		(0.141)
Friedrich		-0.043		-0.054
		(0.106)		(0.101)
female		-0.011		-0.009
		(0.062)		(0.061)
(Constant)	0.999***	0.921***		
	(0.121)	(0.091)		
Hour fixed effects	yes	yes	yes	yes
Day fixed effects	yes	yes	yes	yes
N	261	212	261	212

Note: Dependent variable: dummy "cross" equal to 1 when cyclist violates the traffic rule. The sample includes only observations when no other bystander is present but for the observing children and the accompanying parent. Models 1 and 2 report OLS regressions, Models 3 and 4 Logit regressions, with hour of the day and day fixed effects. Robust standard errors are calculated. Models 2 and 4 include controls for observables. Symbols ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

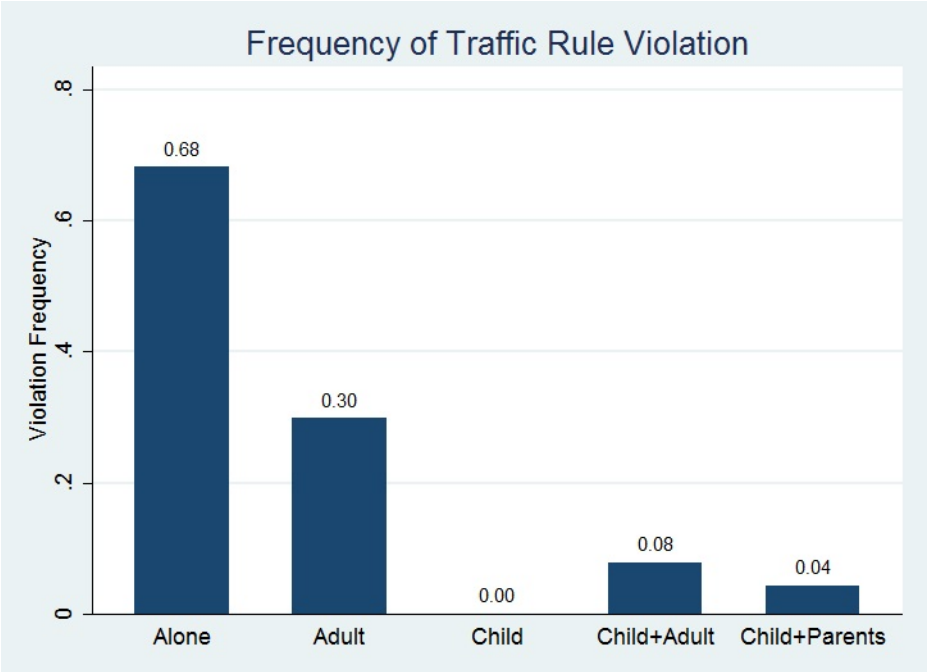
making unanticipated movements, would be considerably reduced because there is more time for everyone to react. We replicate the same regression models proposed in Table 2 but considering only this restricted sample. Results reported in Table 8 in the Appendix are qualitatively the same, confirming the main findings.

[14] We only recorded a dummy coded 1 if at least one other individual in addition to the children and their accompanying person, was waiting at the crossroads; otherwise a zero was recorded. However, we cannot estimate the effect of the size of the audience, since, apart from the aforementioned dummy, we did not collect data on the number of bystanders observing the compliance decision.

3.3 Analysis of the vignette experiment

We now turn to the results of our vignette experiment. Figure 2 depicts the frequencies of non-compliant decisions across all treatments. Descriptively, these results are in line with the field data. The frequency of non-compliant decisions is much lower when the presence of a child was described than when a child was not present in the description: in the "Alone" and "Adult" scenarios, the frequency of rule-violating decisions was 68.3% and 29.8%, respectively; in the "Child", "Child & Adult", and "Child & Parents" scenarios, the frequency of non-compliant decisions was 0%, 7.8%, and 4.3%, respectively. In comparison to the results from the field, there is one significant difference. In the vignette experiment, the presence of an adult observer reduces the frequency of non-compliant decisions from 68.3% in the "Alone" scenario to 29.8% in the "Adult" scenario. In data from the field, the frequency of jumping the red light is much less reduced when only an adult is present and

Figure 2: Frequency of Traffic Rule Violation by Treatment



Note: Frequency of traffic rule violation in the vignette experiment. The five categories refer to the scenarios to which participants were randomly allocated. From left to right: "Alone" indicates no bystanders are present, "Adult" indicates the presence of adult bystanders, "Child" indicates the presence of just children, "Child+Adult" indicates the presence of children and adult bystanders, "Child+Parents" indicates the presence of children with parents.

this reduction is only weakly significant.

After conducting a χ^2-test, we reject the null hypothesis that the compliance decision is independent from the treatments ($\chi^2 = 113.05, p < 0.001$). Among the treatments that describe the presence of children ("Child", "Child & Adult", "Child & Parents"), however, the null hypothesis cannot be rejected ($\chi^2 = 1.98$, $p = 0.372$). If we compare the compliance rate in the treatment where children are alone ("Child") against the joint sample of treatments where children are accompanied by adults ("Child & Adult" plus "Child & Parents"), the difference is not statistically significant ($\chi^2 = 2.70, p = 0.10$). Thus we

cannot conclude that compliance decisions are independent in these treatments. Therefore, we pull together observations from treatments that describe the presence of children ("Child", "Child & Adult", "Child & Parents", treated onward) on the one hand and those from treatments that do not ("Alone", "Adult", control onward) on the other hand. We test whether the proportion of non-compliant choices is lower when children are present than when they are not. A one-sided two-sample test of proportions leads us to reject the null hypothesis that the proportion of non-compliant choices is equal to or larger when children are present than when they are not ($\chi^2 = 84.018, p < 0.001$). In line with our results from the field, we conclude that the presence of children substantially bolsters rule-compliant behavior in the vignette experiment.

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We then investigate the motivations behind stopping more often when children are present. In Table 5 we report the results of a Logit regression in which the likelihood of violating the law is regressed on the six motives described above. We interact each motive with the dummy "children", which takes the value one in the scenarios where children are present. In comparison to Model 1, Model 2 additionally includes controls for gender, age, and participants' risk aversion. The interaction term "children × role model" is negative and significantly different from zero at 5% level. This result suggests that, holding constant the willingness to act as role model, the presence of children significantly reduces the likelihood of crossing when the traffic light is red, and breaking the law. None of the interaction terms between the dummy "children" and any of the other motives are statistically and significantly different from zero at the conventional level.

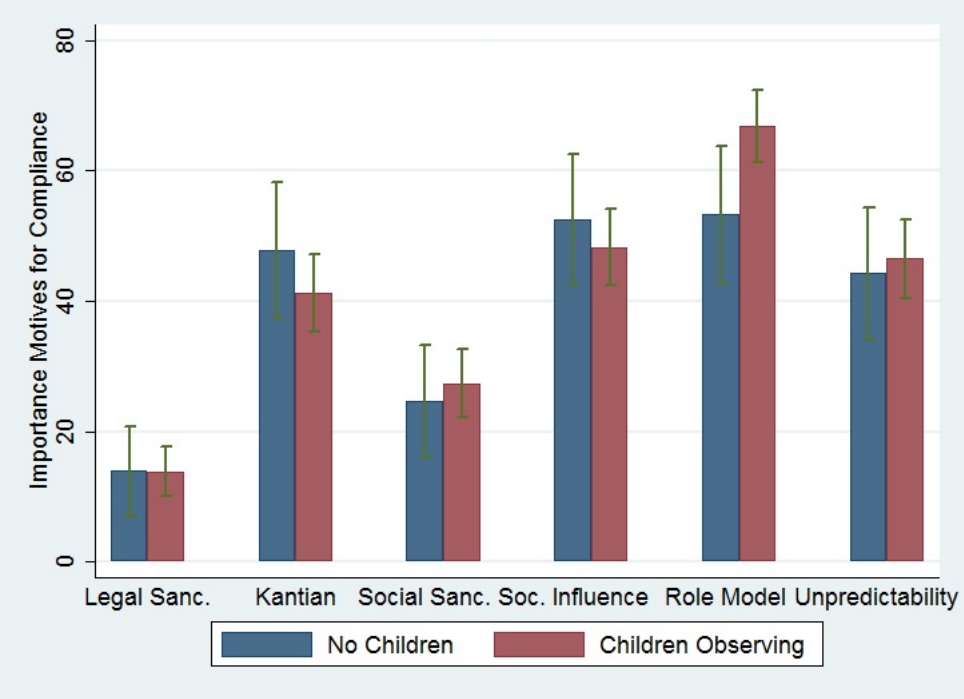
Table 5: Likelihood to Violate the Law and Self-reported Motives for Compliance

	Model 1	Model 2
children	-1.376	-1.535
	(0.971)	(0.990)
role model	0.028**	0.027**
	(0.013)	(0,013)
children × role model	-0.035**	-0.035**
	(0.017)	(0.017)
legal sanction	0.015*	0.015
	(0.009)	(0.009)
children × legal sanction	0.024	0.024
	(0.018)	(0.018)
Kantian concern	-0.019**	-0.019**
	(0.009)	(0.009)
children × Kantian concern	0.002	0.004
	(0.017)	(0.018)
social sanction	0.051***	0.052***
	(0.012)	(0.012)
children × social sanction	-0.032*	-0.031*
	(0.017)	(0.017)
social influence	-0.034**	-0.033**
	(0.014)	(0.014)
children × social influence	0.023	0.021
	(0.019)	(0.020)
safety concern	0.020**	0.019**
	(0.008)	(0.009)
children × safety concern	0.001	0.002
	(0.015)	(0.015)
age		0.005
		(0.028)
female		0.993*
		(0.511)
risk		0.073
		(0.115)
(Constant)	-1.458**	-2.178*
	(0.620)	(1.136)
N	309	309

Note: Dependent variable: dummy "cross" equal to 1 when cyclist chooses to violate the law in the vignette experiment. Logistic regressions. In comparison to Model 1, Model 2 additionally includes controls for age, gender, and risk attitude. Symbols ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

We proceed by focusing on participants who self-reported to be compliant with the law and thus would stop at the red light. We examine the results regarding self-reported motives underlying their decision. Figure 3 depicts the average of the self-reported motives for compliance with the law in treated and control groups. From the six motives that we elicited, only the mean weight of the role-model motive clearly exhibits an upward shift in the three treatments describing the presence of a child. A two-sided t-test comparing the means of the role model motive between groups reports that the difference is significant at the conventional level ($t = 2.36, p = 0.018$). We find no significant differences between

Figure 3: Average Motive Weights for Compliant Choices



Note: Self-reported motives for compliance with the traffic rule on a 0-100 scale. The blue bar includes situations where no children are present in the scenario. The red bar includes situations where children are observing.

treatments with and without children observing for the other five motives.

This result is confirmed by a multi-variate regression. Conditional on reporting the decision to stop at the red traffic light, the six motives enter the analysis as a matrix of response variables. To establish comparability with the field data, we again merge the treatments describing the presence of children and those that do not. The resulting dummy variable enters as predictor variable.[15] Participants' gender, age, and self-reported measure for general risk taking enter as control variables.[16] Table 6 reports the results. The presence of children in the treatments has a positive and significant effect on the motive to be a role

[15] We also run a separate multi-variate regression model in which we isolate the effects of the treatment "Child", in which children are waiting alone at the traffic light, from the treatments "Child & Adult" plus "Child & Parents", in which children are accompanied by adults. As it was the case for the compliance decisions in observational data and for the self-reported compliance rate in the survey experiment, the results are statistically the same for the two sub-samples of treatments.

[16] In a series of robustness checks, we verified that the exclusion of the controls does not affect the results.

model ($p = 0.031$). Otherwise, however, the presence of children has no effect on the motive weights of compliant participants.

Table 6: Motive Weights of Compliant Participants – Effect of Children Presence

	Motive 1: Legal sanction	Motive 2: Kantian concern	Motive 3: Social sanction	Motive 4: Social influence	Motive 5: Role model	Motive 6: Safety concern
children	-0.482	-6.404	2.250	-3.756	13.318**	2.184
	(3.81)	(5.82)	(5.05)	(5.57)	(5.38)	(5.83)
age	-0.514***	0.167	-0.395	0.399	-0.118	-0.181
	(0.18)	(0.28)	(0.25)	(0.27)	(0.26)	(0.28)
female	-3.506	-4.670	2.969	-11.207**	7.663	-9.212
	(3.83)	(5.85)	(5.08)	(5.60)	(5.40)	(5.86)
risk attitide	-1.841***	-5.039***	-3.614***	-4.930***	-5.919***	-4.685***
	(0.71)	(1.08)	(0.94)	(1.03)	(1.00)	(1.08)
(Constant)	31.479***	65.369***	45.418***	66.871***	76.710***	67.991***
	(5.63)	(8.61)	(7.47)	(8.24)	(7.95)	(8.62)
N	240	240	240	240	240	240
R^2	0.060	0.093	0.070	0.112	0.158	0.084

Note: Multivariate regression, the six motives enter the analysis as a matrix of response variables. Age, gender, and risk attitude serve as additional controls. Symbols ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

As additional evidence supporting our hypothesis that the willingness to act as a role model is the leading motivation driving compliance when children are present, we replicate the multi-variate regression model presented in Table 6, but focus on the self-reported motivations for complying with the law expressed by participants in the treatment "Adult" (where only adults bystanders are observing). We compare those motivations with the ones reported in the "Alone" treatment where nobody is present at the crossroads. The results are reported in Table 7. The only motive for compliance significantly different from zero at the conventional level is the concern for social sanctions (i.e. "I don't want my fellow men yelling at me about crossing the red light."). The coefficient of the role model motive is not statistically different from zero and, if anything, the point estimate is negative. This result provides further support to our claim that, in presence of children who are considered highly receptive to educational inputs, the role model effect is an important factor shaping people's willingness to abide by the law. Conversely, this driver of compliance loses importance when compliance decisions are observed by adults, whose identity is arguably less malleable and less subject to the influence of their peers' example.

Table 7: Motive Weights of Compliant Participants – Effect of Adults Presence

	Motive 1: Legal sanction	Motive 2: Kantian concern	Motive 3: Social sanction	Motive 4: Social influence	Motive 5: Role model	Motive 6: Safety concern
adult	-4.886	-2.972	17.170**	-15.976*	11.694	11.520
	(6.81)	(10.39)	(8.36)	(9.19)	(9.42)	(9.21)
controls	yes	yes	yes	yes	yes	yes
(Constant)	47.725***	81.847***	49.035***	96.592***	99.050***	100.886***
	(10.44)	(15.92)	(12.82)	(14.09)	(14.44)	(14.12)
N	60	60	60	60	60	60
R^2	0.32	0.34	0.31	0.21	0.17	0.18

Note: Multivariate regression, the six motives enter the analysis as a matrix of response variables. Controls include age, gender, and risk attitude. Symbols ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

4 Discussion and conclusion

In economic analysis of the law, the traditional approach to deter socially undesirable behavior consists of providing monetary incentives and imposing external constraints through contract, law, or regulation. Research streams in behavioral law and economics have elaborated the role of decentralized enforcement and the importance of social and psychological costs for deterrence, i.e., the importance of social norms and internal constraints in redirecting individual decisions. Our paper contributes to this line of reasoning. We provide evidence that agents' decisions to comply with the law are influenced by the desire to act as a role model and so advance the social good in avoiding negative compliance externalities.

We look at cyclists' compliance decisions regarding the well-known traffic rule that one should stop at a red traffic light. If cyclists care about being a role model when deciding whether to comply with the traffic rule or not, the prediction is that compliant behavior will occur more often when children are observing, because one expects the consequences of educational inputs to have the highest influence at a young age. In the field, we find that the presence of children has a significant effect on the decision to comply with traffic rules: cyclists ignore the red traffic light much less frequently when children are observing them. The compliance decisions in our vignette experiment display similar results. When asked about the motivation behind the (non-)compliance decision, only the importance of the role-model effect stands out among the respondents' stated motivations for compliance in the presence of children.

These findings contribute to the law and economics literature on compliance behavior by providing empirical evidence of the hypothesis that compliance externalities are an important determinant of the decision to abide by rules. Some scholars argue that the outstanding degree of pro-sociality that characterizes humans in the animal world is the byproduct of a unique ability to learn (Cushman, 2013). The evidence reported in this paper shows that decision-makers anticipate the pedagogical value of setting a good example and that their actions are guided by the willingness to foster pro-social behavior.

Our results also relate to the law and economics literature on social norms. According to this line of research, pro-social behavior is not the outcome produced by well-defined and stable preferences over payoff distributions, but rather by preferences for following known

social rules. These social rules specify the most socially appropriate action for the decision maker given a set of circumstances. When the decision maker evaluates a possible action, she compares it to an external, socially defined normative standard, and judges her own behavior according to its conformity to this norm.[17] To the extent that the norm is pro-social, a person who suffers more from violating norms will behave more pro-socially. In this sense, "norms make preferences social" (Kimbrough and Vostroknutov, 2016, p. 3).

In the decision situation, which characterizes the society we study, acting as a role model in order to educate children regarding compliance with rules is a shared social value. Hence, individuals are willing to incur a cost, in our case the cost of "teaching by demonstration" (Ho et al., 2016) through complying with the law and waiting at a red traffic light, in order to display the prescribed behavior. If the outcomes of compliance decisions are to some extent the results of socially defined standards, lawmakers possess valuable tools for shaping compliance behavior. For instance, it has been suggested that the law can create focal points to emphasize pro-social norms of compliance (McAdams, 1997). Lawmakers can also promote norm campaigns that raise people's awareness regarding compliance with selected social issues (Cooter, 1998; Posner, 2000; Benabou and Tirole, 2011). As a final example, lawmakers can award ex-post prizes and recognition that encourage pro-social actions carried out by "norm entrepreneurs" (Sunstein, 1996; Bruni and Sugden, 2013).

A limitation of this paper is that results of the vignette study might be subjected to methodological issues characterizing self-reported data. Indeed, while not directly related to our research question, the observed discrepancy in compliance rates for cases in which an adult bystander is present between the (not incentivized) self-reported likelihood of stopping at the red light in the hypothetical situation of the survey and the (costly) observed compliance decision in the field more generally casts doubts about the reliability of the data. It is possible that a demand effect inflated participants' self-reported compliance intentions in situations where another adult is observing, while in reality the presence of an adult bystander has a much smaller effect on being law-abiding.

We acknowledge that demand effects are in general an issue for the reliability of self-reported data. On the other hand, we believe that our research design partly mitigates these concerns. First, we implemented an experimental survey based on a between-subject design in which we tried to minimize differences in wording among treatments (i.e. only the vignette that graphically represented the situation, and the few words referring to it, differed among scenarios). Any other element of the procedure was kept identical for each participant, including the large majority of words used for describing the scenario and the order of questions. Therefore, while we cannot exclude that in general demand effects influenced the results of the vignette study, we believe that by comparing the self-reported answers of participants exposed to exactly the same procedures and wording, except for a graphical element and its description, we have reduced to some extent concerns regarding this issue. Second, if we exclude the case in which a bystander alone was present, self-reported data on compliance are strikingly similar to observed data in the field. The sharp increase in compliance in situations where children are present is registered both for self-reported and observed choices. This finding again makes us more confident about the reliability of the results of the vignette study.

A second limitation of our work is that data from the field study are gathered in a specific location of one German city. Further research is needed to identify socio-demographic contexts where our results hold, and to understand to what extent they can be generalized to other cultures and societies.

[17] This idea can be modeled with a simple utility function in which deviations from norms generate a utility cost.

Moreover, our study is silent regarding the role model effect on agents' decisions to violate more serious rules and regulations, such as engaging in robbery, tax evasion or other criminal activities. We agree that it is plausible that the role model effect vanishes in these and other similar contexts (but still has to be proved). Nonetheless, we also believe that perceiving themselves as a role model can influence many day-to-day decisions which are characterized by risks of important economic consequences, such as speeding, re-cycling, consuming energy, free-riding on public transport, or littering.

Future research will need to investigate whether the role model effect is relevant in situations in which deterrence is actually present and relevant. Moreover, researchers will have to isolate the psychological mechanisms underlying compliance decisions in the presence of compliance externalities.

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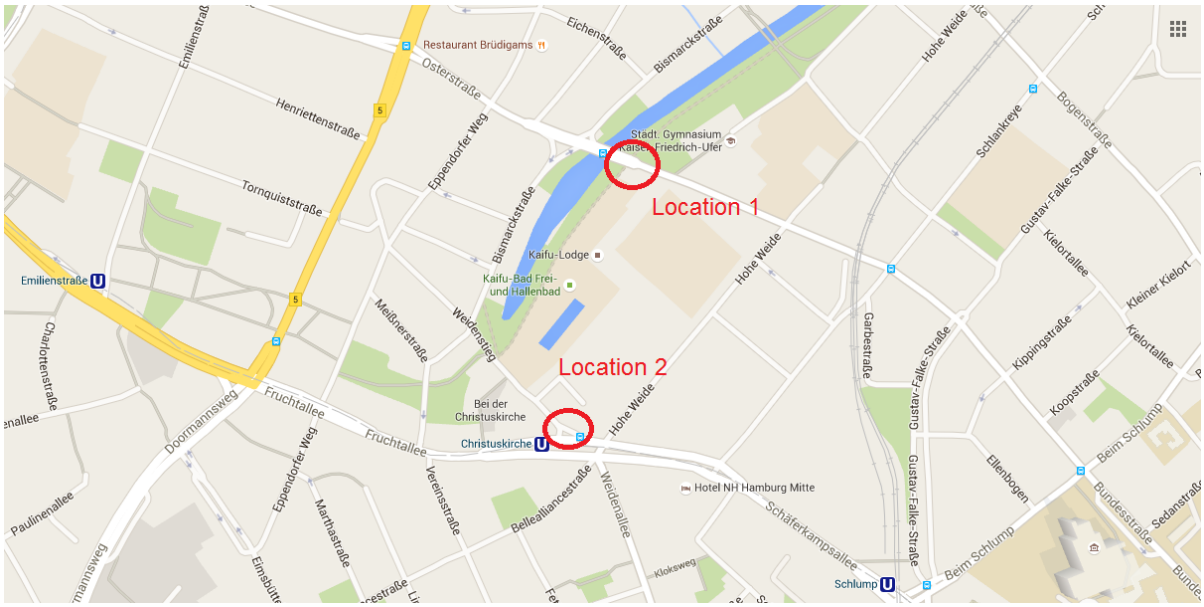
Appendix A:

The map shows the two locations in Hamburg at which the data of the field study were collected.

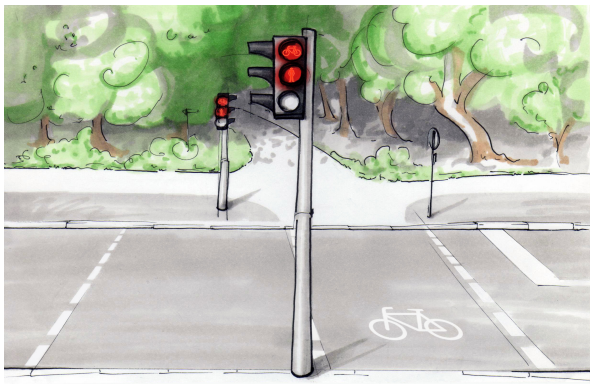
Figure 4: Locations where Field Data were gathered (Hamburg, Germany)



Appendix B:

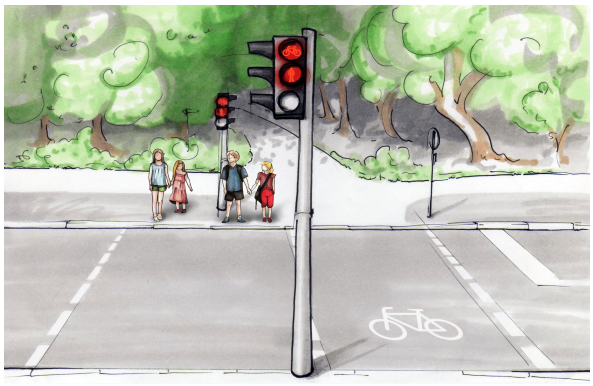
The following five figure shows the illustrations that augmented the scenario descriptions in the vignette experiment. Scenario illustrations are courtesy of Lien Debrouwere (www.elle-dee.be).

Figure 5: Scenario Illustrations in the Vignette Experiment



(a) Scenario: "Alone"

(b) Scenario: "Adult"



(c) Scenario: "Child"

(d) Scenario: "Child & Adult"

(e) Scenario: "Child & Parents"

Appendix C

Table 8: Probability of Traffic Rule Violations

	Model 1	Model 2	Model 3	Model 4
children	-0.541***	-0.499***	-0.597***	-0.544***
	(0.084)	(0.106)	(0.147)	(0.197)
old		-0.256***		-0.232***
		(0.056)		(0.043)
morning		0.458***		0.528***
		(0.131)		(0.148)
peak		-0.238**		-0.220**
		(0.119)		(0.106)
Friedrich		-0.160*		-0.162*
		(0.094)		(0.092)
female		-0.122**		-0.121**
		(0.050)		(0.050)
(Constant)	0.954***	0.942***		
	(0.102)	(0.073)		
Hour fixed effects	yes	yes	yes	yes
Day fixed effects	yes	yes	yes	yes
N	391	307	391	307

Note: Dependent variable: dummy "cross" equal to 1 when cyclist violates the traffic rule. The sample excludes observations where observing children and cyclists engaging in the compliance decisions are on the same side of the street. Models 1 and 2 report OLS regressions, Models 3 and 4 Logit regressions, with hour of the day and day fixed effects. Robust standard errors are calculated. Models 2 and 4 include controls for observables. Symbols ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.