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Nudging student recycling behaviour: An experimental study in Kazakhstan and UK higher education

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ABSTRACT

We study the effects of influencing the recycling decisions of young people in the UK and Kazakhstan Universities using a public good experiment with an information nudge (through a video) and a peer effect nudge. Kazakhstan recycles approximately 15% of its municipal waste, compared to almost half in the UK; however, surprisingly, overall contributions are significantly higher from Kazakh students compared to those from UK students. An information video on recycling prompts Kazakh students to contribute more while no such effect is found with the UK students. This suggests that Kazakh students may perceive themselves to be more capable of recycling despite a less sophisticated recycling system compared to the UK. A strong peer effect is seen across both countries. The study highlights the importance of subjective norms through peer nudge and the likelihood of higher contributions from students with siblings. A wider implication is that emerging economies' educational institutions may have latent positive environmental and recycling practices that developed nations could learn from. The study has implications for educational development as well as national recycling policy frameworks.

1. Introduction

The planet is “wasting away”; over 2.12 billion tons of solid waste are globally generated, set to grow by 70% annually in the next 30 years (World Bank, 2018). Raising public awareness and promoting new social norms to recycle and reuse products is paramount. In 2015, the United Nations identified Sustainable Development Goals (SDGs) as an agenda for global development; the 12th SDG, “responsible consumption and production” relates closely to recycling and waste prevention. Countries are getting cognizant of this issue and are responding (United Nations Environment Programme (UNEP), 2022).

While policy action is paramount, there is a chasm between official goals and public responsiveness (Issock et al., 2021). Clarity is needed to decide what strategies should be optimally adopted to induce effective behavioural change so that awareness, intention, and adoption of recycling are successful. (Goldman et al., 2018; UNEP, 2022). The degree of national recycling is however varied: the UK, a developed market

economy, with \$3.34 trillion GDP in 2021 (current PPP) recycles around 45% of its household waste (Gov.UK, 2022); Kazakhstan, an emerging economy, has ambitious targets, currently recycling approximately 15% of its waste (EGov, 2022) with commensurate GDP of \$543.47 billion (World Bank Data, 2021).

Several authors (e.g., Sánchez-Llorens et al., 2019; Aleixo et al., 2021; Boulet et al., 2022) argue that the young benefit the most from a sustainable environment. Hua et al. (2021) suggest that literate adults should be the focus of research, but it is unclear how their decision-making is influenced (Aleixo et al., 2018; Bonera et al., 2020). The research question we ask is, “What makes higher education adults respond to recycling?” Specifically, the research aim is to evaluate the impacts of recycling knowledge and peer effect (PE) on decision-making. Pursuant of these, we report on a public good game involving students from two universities in UK and Kazakhstan, in a laboratory setting, to investigate behavioural choices regarding charitable donations made to an imaginary household waste recycling project.

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This research extends the study based on experiments in Fischbacher et al. (2001) to ask if young people are conditionally cooperative. Inheriting from previous literature, we develop the methodology by conducting an experiment to measure nudge interventions (nudges) on recycling behaviour. Contrasting countries were chosen to investigate whether recycling is cultural (Bovens, 2010; Fisher et al., 2012), motivated by similar pro-environmental studies, e.g., Davison et al. (2022) which compares university students from UK and India, with different socio-economic landscapes. Mindful of previous literature, we explore for a country effect to explore whether responses from a developed country are different to those from an emerging economy.

We make three contributions. This is a pioneering paper that applies the concept of the public good games to investigate recycling behaviour with laboratory data. Secondly, we test nudge theory on recycling decision-making, adding to extant studies. The results offer suitable measures to inform recycling behaviour, especially considering students' characteristics. In doing so, we investigate the impact of individual and altruistic (givers and takers) characteristics. To our knowledge, no study has explored the latter so far. Finally, the comparison between the UK and Kazakhstan illuminates the nudges' impacts between contrasting recycling rates in an industrialised economy and an emerging one.

2. Literature

2.1. Recycling and nudges

The recycling dilemma has theoretical grounding in cooperative game theory and public goods games (Tomassini and Antonioni, 2020). Experimental game studies are useful in predicting how individuals contribute to the effective use of public goods and collectivism (Schram, 2002). Work on social norms behaviour (Sunstein, 1996; 2014; Thaler et al., 2013) has been influential; effective maintenance of public goods and positive externalities rely on social norms (Sunstein, 1996); nudges (policy interventions) may help. Thaler and Sunstein (2008) define a nudge as "... any aspect of the choice architecture that alters people's behaviour in a predictable way without forbidding any options or significantly changing their economic incentives. To count as a mere nudge, the intervention must be easy and cheap to avoid. Nudges are not mandates." Waste prevention policy through nudges would encourage responsible recycling, demanding individual action but preventing an insurmountable problem. Nudges have been widely accepted by governments e.g., the US and UK (Halpern, 2015). Bicchieri and Dimant (2019) discuss the effective design of nudges.

A difficulty arises here. Nudges are sensitive to culture (Bovens, 2010; Davison et al., 2022); pro-environment behaviour is demographically dependent (Schultz et al., 1995; Fisher et al., 2012). Studies propose education as an instrument towards sustainability (e.g., Leal Filho et al., 2019; Salazar et al., 2022). Reports suggest that young people may not always engage with green issues (Ojala, 2008; Bonera et al., 2020). Moreover, waste recycling rates can differ by demographics (Abbott et al., 2013), ethnicity (Ghazali et al., 2019) and social heterogeneity (Bouma et al., 2008). In the UK, recycling policy has been prevalent for some years (Bartl, 2014; Oluwadipe et al., 2022); in Kazakhstan, it is aspirational, but nascent (Noya et al., 2018; Skryhan et al., 2018).

One method to understand issues is using secondary data such as a data set on recycling rates and policy determinants for UK's local authorities (Abbott et al., 2013). However, not policy alone, but individual behaviour determines success (Martin et al., 2006; Hua et al., 2021).

2.2. Studies on students and methodology

Recycling is essential to sustainability (e.g., Ramayah et al., 2012; Ahmad et al., 2016). Aleixo et al. (2018, 2021) study Portuguese students. Some are actively involved in sustainable practices; a small group

remain sceptical. Davison et al. (2022) explore the impact of behavioural change interventions to reduce food waste in two universities from India and UK. They found that interventions have greater impact in India. Similarly, researchers (e.g., Jibril et al., 2013; Pamuk and Kahriman-Pamuk, 2019) highlight the importance of attitude, intention, values and habits; others (Schwab et al., 2014) emphasize mind-set, perceptions and past experiences; some other authors (Sánchez-Llorens et al., 2019; Hua et al., 2021) stress socioeconomic characteristics, and other psychological settings.

In contrast to surveys, laboratory experiments have recently gained favour. Revealed preferences through experiments can convey intuitive information effectively guiding policy spending. Kronrod et al. (2012) test the impact of assertive green messages on consumers using Google Ad words. Camargo and Bender Haydu (2016) examine the viability of using common pool games on college students to ascertain whether experienced members' messaging to newcomers is influential. Isaksen et al. (2019) examine whether the type of framing effects influences outcomes. Bouma et al. (2008) use experiments to explore the interplay between social capital, community characteristics and the provision of semi-public goods.

2.3. Theory of planned behaviour

The theory of planned behaviour (TPB) (Ajzen, 1991) is widely used to explain individuals' recycling behaviour. In addition to personal characteristics (demographics, risk preferences, personality traits), behaviour is formed from intention, determined by attitude, subjective norms (importance placed by kin, family, society, religion, and peers) and, perceived behavioural control (the perceived capability to realise the goal/self-efficacy). Fig. 1 illustrates the components of TPB along with related characteristics.

Several studies advocate the importance of social norms to change cognitive biases (Nyborg et al., 2006; Brekke et al., 2010). International recycling studies (Aguilar-Luzón et al., 2012; Onwezen et al., 2013) use surveys to understand how TPB incorporates intention with norms to explain behavioural variation. Sarbassov et al. (2019) suggests bin installation (perceived subjective control) and public awareness in Nur-Sultan, Kazakhstan, would increase uptake. Tonglet et al. (2004) propose that pro-recycling attitudes are the main determinants of UK recycling, besides previous experience, community concern, and consequences. Bezzina and Dimech (2011) propose nine factors: individual attitudes, norms and skills, satisfaction with services, inconveniences, awareness of consequences, knowledge of issues, social norms, motivating factors, intentions to act and, scheme preference. Liu et al. (2022) survey New York households finding subjective norms, and perceived behavioural control are positively related to recycling intention. Corrado et al. (2022) provides a rich seam of literature linking ease, motivation, and awareness of recycling and pro-environment behaviour. It is thus clear that demographics, subjective norms as well as perceived control to change through the provision of facilities, are important.

We do not directly test TPB but use its framework as a guide. Instead, we investigate whether nudges are influential in changing subjective behaviour norms, latent perceived capabilities, and base attitudes.

3. Methodology

3.1. Rationale and steps

Laboratory experiments have several advantages (Schram, 2002; Ubaydli and List, 2015): providing the means to control conditions (Isaksen et al., 2019), exploring potential paths of new research and offering fresh insight in absence of established theory. Experiments allow replication, assist in systematic analysis of the findings' robustness, reveal inner intuitive motives (Fischbacher and Föllmi-Heusi, 2013) and generate an identifiable subset of unbiased data (Prince et al., 1992). Using surveys may result in sacrificing accuracy: respondents

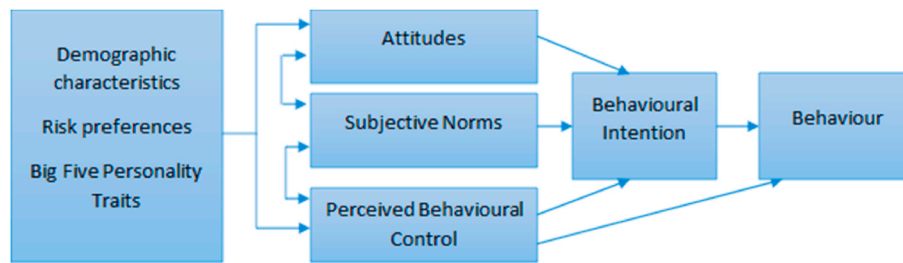


Fig. 1. The theory of planned behaviour.

taking shortcuts such as straight-lining i.e., selecting the same option (Cole et al., 2012; Zhang and Conrad, 2014); response rounding (Holbrook et al., 2014) and rushing through (Ansolabehere and Schaffner, 2015). We use the public good game (Ledyard, 1995) since it provides a generic framework to examine social dilemmas (Waichman and Voss, 2016) and promote cooperation (Fehr and Gächter, 2000). Our aim is to examine whether participants contribute to public recycling behaviour projects. Based on the above literature, this is the most appropriate experiment to apply.

The public good experiment examines the students' behaviour, during 2019, from the University of Lincoln (UK) and Seifullin Agro Technical University (Kazakhstan). Cross collaborations between academic faculties allow ease of comparison. The experiments were first conducted (summer), in UK and subsequently (autumn) in Kazakhstan using initial pilot runs, in computer labs. Seventy-two applicants from each country participated split into 3 treatments of 24 members each. Each treatment consists of 6 groups of 4 members. We use the between-subject design; every subject plays one treatment and makes the same decision 6 times.

Subjects were given a token amount and asked for a voluntary donation to a public project through a game for the treatments. Before leaving, subjects completed a questionnaire on their demographic characteristics, risk preferences and Big Five personality traits. Risk preferences are measured by the questionnaire in Dohmen et al. (2011) and the Holt and Laury experiment (2002) through a lottery game; Big Five Personality Traits are the 44-items BFI (Benet-Martínez and John, 1998), which is used to measure Extraversion, Conscientiousness, Agreeableness, Neuroticism and Openness to Experience.

Given the literature, we expect these characteristics to affect individual recycling decisions. Subjects are given a cash reward independently, dependent on individual decision-making. This money comes from our internal research budget. The average payment is £9 for a 45-min experiment, which includes a £3 show-up fee. In total, our data comprises 72 subjects from each country, i.e., a total of 144 subjects. Section 3.1 explains the treatments. Figure A1 (Annex) summarises the steps. Figure A2 (Annex) summarises the Framework of Methodology.

3.2. Experimental design

There are three treatments: the Base case, the Information effect, and the Peer effect (PE). The experiment is programmed with z-tree (Fischbacher, 2007).

3.2.1. The base

We follow the standard design introduced by Fischbacher et al. (2001). Four subjects form a group to play the one-shot public good game. Every subject receives 20 ECU (Experimental Currency Unit) at the beginning of the experiment, from which the subject decides to contribute a proportion/all to a public project. Participants are informed that each 25 ECU is worth £1. The size of the project is the sum of all contributions (g) while the marginal payoff of the contribution is 0.4 ECU. The subjects' payoff, therefore, is calculated by using the following formula:

$$\pi_i = 20 - g_i + 0.4 \sum_{j=1}^4 g_j$$

Apart from the remaining amount of money left after the contribution, each participant receives 40% of the total contributions to the public project. Accordingly, participants receive more money if they contribute more to the project. Our a priori expectation is that subjects will contribute, but we are uncertain of the extent.

3.2.2. The information effect

Treatment 2 is similarly conducted with one exception; a video is played immediately after reading the experimental instructions, to each participant. The content of the video focuses on the recycling situation in the UK/Kazakhstan and how each individual could help. We expect with this information, individuals are more likely to play their role to improve the recycling situation by contributing to the public project. Therefore, the average contribution in this treatment is expected to be significantly higher than the base treatment where individuals did not receive any additional information.

3.2.3. The peer effect (PE)

Treatment 3 is conducted to test whether the behaviour of others influences willingness to contribute. Accordingly, prior to the decision-making, subjects are informed about the highest average contribution from the base treatment. Fosgaard et al. (2017) indicate that the framing effect will be insignificant if subjects are well informed about the payoff. We ensure that payoff is explained and expect subjects to change/increase their contribution behaviour due to the PE.

We expect a difference between the two countries' average contributions.

4. Results

Our discussion is divided into two parts-preliminary findings using nonparametric tests are shown in sections 4.1-4.4. Based on these findings, we subsequently present results from regressions in section 4.5.

4.1. Preliminary findings

Table 1 shows the average contributions over the 6 periods by

Table 1

Average contributions.

Contribution	All	UK	KZ	p-value (UK-KZ)
BASE	10.61	9.45	11.76	0.001
VIDEO	11.19	9.61	12.77*	0.000
PEERS	12.78***	10.10	15.45***	0.000
Observations	144*6	72*6	72*6	

p-values are taken from the Mann-Whitney U test.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

treatments and countries, respectively.

In the Base treatment case, the average contribution is 10.61 overall for all students. These corroborate previous studies' findings suggesting that about half the endowment is donated to the public choice project (Tomassini and Antonioni, 2020) i.e., average contributions are around 50% of the endowment. As anticipated, video and PEs improve contributions to 11.19 and 12.78 on average, respectively. The latter treatment shows a statistically significant impact; when participants know that the average contribution of peers is 10, they significantly increase their contributions. A significant PE is from Kazakhstan (KZ) where the average contribution is significantly higher than the UK in all treatments. The effect of both nudges is statistically significant while, surprisingly, not in the UK. The results from Kazakhstan still suggest that the video effect is weaker than the PE increasing average contributions by about 30%.

Next, we categorise subjects who contribute over 75% of their total wealth as "givers" and under 25% of their total wealth as "takers". (For robustness, we try a 50% category and find results unchanged.) Out of all participants, 31.94% of them are givers and 14.58% of them are takers, who contributed more than 75% and less than 25% of their wealth, respectively. The remainder is people in between.

Table 2 illustrates the number of givers and takers in the three treatments (Panel A) and by country (Panel B).

The number of givers is significantly higher for PE compared to the Base. In contrast to takers, givers are also significantly higher overall (PE). However, the separation of takers in each treatment shows that the number of takers in the Base treatment is relatively higher compared to the video and PE. After receiving information about recycling and the contributions of their peers, they become givers. This explains the significantly high givers in PE.

Between the two countries, the number of givers is twice as large, and the number of takers is twice as low in Kazakhstan compared to the UK participants. Two-thirds (32/46) of givers are Kazakh and most takers are from the UK (17/21).

4.2. Changes in contributions over repeated rounds

Persistence through repeated rounds can play a powerful role in sustained behaviour; a one-time nudge may be insufficient. We plot changes in contributions, over the six periods, played per treatment in Fig. 2 (a, b, c).

Table 2
Givers and takers.

Panel A: Separate into 3 treatments			
	Giver	Taker	p-value (Giver vs. Taker)
ALL	46 (31.94%)	21 (14.58%)	0.002
BASE	12 (25.00%)	9 (18.75%)	0.512
VIDEO	12 (25.00%)	6 (12.50%)	0.157
PEERS	22** (45.83%)	6 (12.50%)	0.002
Panel B: Separate into countries			
	Giver	Taker	p-value
ALL	46 (31.94%)	21 (14.58%)	0.002
UK	14 (19.44%)	17 (23.61%)	0.590
Kazakhstan	32*** (44.44%)	4*** (5.56%)	0.000

p-values are taken from the Mann-Whitney U test.

p-values are taken from the Mann-Whitney U test and Wilcoxon signed-rank test.

***p < 0.01, **p < 0.05, *p < 0.1.

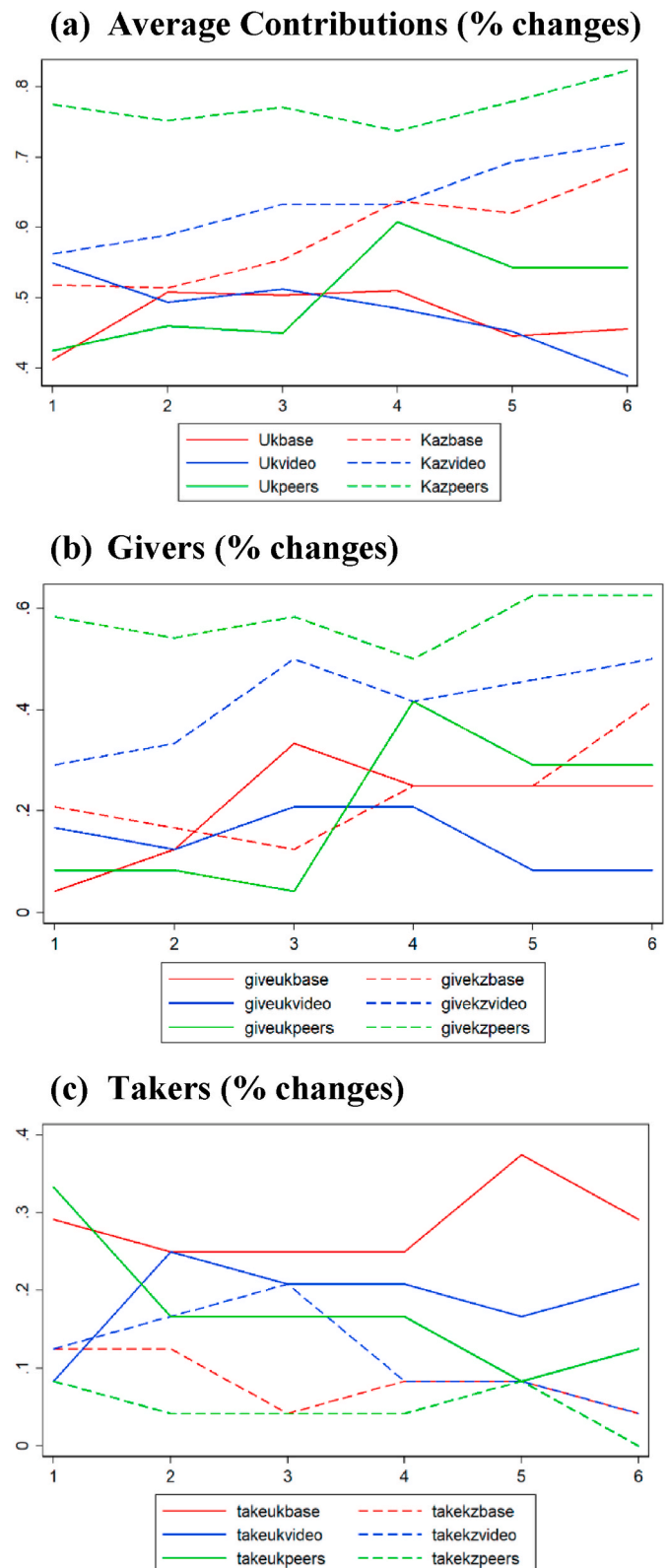


Fig. 2. Contributions, givers and takers over six periods.

Participants play each round (period) independently; Fig. 2(a) shows contributions from Kazakh participants are higher in all cases and increase as rounds are played. In UK, the opposite occurs, (video

treatment) creating a widening gap. Contributions of participants from both countries are almost matched at commencement. As successive rounds are played, the gap widens. In the end, Kazakh contributions are twice the size of UK contributions. These might explain the insignificant impact of video treatment (Table 1).

The patterns suggest, in some cases, givers increase in successive rounds (Fig. 2 (b) and (c)). More givers, but also fewer takers, emanate from Kazakhstan. Apart from the video treatment case, there is no link suggesting that previously observed falling contributions lead to increasing UK takers. Note that these capture the cut-off at 75%; most contributions are circa 50–60%.

4.3. Individual characteristics and recycling behaviour

International comparison of contributions shows that Kazakh participants contribute more; this also grows over the periods and the opposite can be said about participants in the UK experiment. To understand this further we explore for differences in the participant characteristics in Table 3.

Kazakh participants are mostly male, and/or from natural science majors compared to those from the UK. Natural science students would likely to be open to the impact of recycling on the living environment (Meyer, 2016). The fraction of international students in Kazakhstan universities is normally low and students are partly Kazakhs, partly Russians, Ukrainians, Germans, Koreans, Tatars etc. They are native to and resident in Kazakhstan. Hence, Kazakh students are all classified as 100% nationals. In the UK subject pool, 47.22% are non-Western students, while the rest are from UK and other European nations.

Half of the UK participants (53%) are international and have fewer siblings, unlike participants in Kazakhstan, who are homogenous. Significant differences occur in satisfaction with health, sleep, income, and

Table 3
Characteristics of the subject pool.

Characteristics	All	UK	Kazakhstan	p-value (UK vs. KA)
Age	20.46	22.71	18.22	0.000***
Gender (Male)	87 (60.42%)	38 (52.78%)	49 (68.06%)	0.061*
Major (Natural Science)	47 (32.64%)	6 (8.33%)	41 (56.94%)	0.000***
Nationality	106 (73.61%)	34 (47.22%)	72 (100%)	0.000***
Younger siblings	0.82	0.63	1.01	0.030**
Risk preference				
Risk general	6.06	5.80	6.31	0.166
Risk Finance	5.26	4.98	5.54	0.213
Risk driving	3.32	3.00	3.65	0.159
Risk Faith	4.84	5.18	4.50	0.154
Risk Health	3.93	3.95	3.91	0.806
Risk HL (Holt and Laury, 2002)	5.36	6.02	4.69	0.000***
Satisfaction				
Satisfaction health	7.48	7.18	7.79	0.012**
Satisfaction sleep	6.86	6.37	7.34	0.010**
Satisfaction study	6.92	6.45	7.38	0.003***
Satisfaction income	5.21	4.62	5.80	0.012**
Satisfaction dwelling	6.93	6.05	7.80	0.000***
Satisfaction free time	6.87	6.59	7.15	0.094*
Satisfaction life	7.29	7.00	7.58	0.006***
Stability				
Ladder	6.25	6.26	6.25	0.817
Financial management	3.31	3.27	3.36	0.028**
Big Five Personality				
Extraversion	3.29	3.30	3.28	0.905
Agreeableness	3.61	3.69	3.54	0.053*
Conscientiousness	3.56	3.48	3.63	0.123
Neuroticism	2.70	2.75	2.66	0.480
Openness	3.52	3.44	3.60	0.088*

p-values are taken from the Mann-Whitney U test.
***p < 0.01, **p < 0.05, *p < 0.1.

Table 4
Correlation of characteristics with absolute contributions.

Characteristics	All	UK	Kazakhstan
Age	-0.059	-0.092	-0.168
Gender (Male)	-0.173**	-0.166	-0.143
Major (Natural Science)	-0.032	-0.101	0.037
Nationality	0.009	0.034	-
Younger siblings	0.174**	0.062	0.314***
Risk preference			
Risk general	-0.125	-0.106	-0.204*
Risk F	0.016	0.038	-0.033
Risk driving	0.046	0.070	0.029
Risk Faith	0.046	-0.040	0.172
Risk Health	-0.047	-0.140	0.108
Risk HL	0.005	-0.074	0.045
Satisfaction			
Satisfaction health	-0.019	0.020	-0.073
Satisfaction sleep	-0.077	0.051	-0.212**
Satisfaction study	-0.011	-0.010	-0.038
Satisfaction income	0.043	0.077	0.058
Satisfaction dwelling	0.033	-0.064	0.156
Satisfaction free time	-0.011	-0.008	0.003
Satisfaction life	-0.032	-0.112	0.054
Stability			
Ladder	-0.022	-0.011	-0.007
Financial management	0.131	0.102	0.154
Big Five Personality			
Extraversion	-0.002	0.030	-0.069
Agreeableness	0.074	0.086	0.091
Conscientiousness	0.048	0.078	0.007
Neuroticism	0.067	0.110	0.011
Openness	0.043	0.091	-0.022

p-values are taken from the Spearman's rho correlation coefficient.

***p < 0.01, **p < 0.05, *p < 0.1.

life in general, where Kazakh participants score higher than UK participants, i.e., are more content. There are no significant differences in terms of risk preferences, financial stability, Big Five personality traits, apart from one i.e., Risk measured by Holt and Laury (2002) (significantly higher for UK participants). Summary statistics and the full description of variables are in the Annex section in Table A1.

4.4. Correlations

We also investigate how characteristics are correlated with absolute contributions in Table 4.

The results suggest that males contribute less than females; this correlation is not strong, but the signs remain unchanged within countries. Participants from natural science and nationality are weakly negatively correlated with total contributions. Having more siblings is positively and significantly correlated with contributions and explained by Kazakh contributions. Among the risk parameters, only general risk stands out suggesting that risk-averse participants contribute less than those with lower risk settings. Again, this is significant for Kazakh contributions. Satisfaction characteristics are also weakly correlated with contributions, apart from satisfaction with sleeping. This is a surprise; we expect that persons satisfied with sleeping would be in a better mood and consequently would contribute more.

4.5. Baseline regressions

Previously, we found significant improvements in contributions after applying PE, particularly in Kazakhstan. There are also a higher number of Kazakh givers compared to UK participants, which increases over the periods. Before attributing this to differences in participants, we consider whether other factors, such as interaction or lags, could impact outcomes. Thus, we turn to panel data regression analysis. Specifically, we estimate the contribution of participant *i* of session *j* receiving treatment *k* and playing *t* periods of time:

Table 5
Baseline regression results with contributions.

VARIABLES	(1)	(2)	(3)	(4)
	Contribution	Contribution	Contribution	Contribution
Video	0.973 (0.987)	0.921 (0.971)	-0.360 (0.373)	-0.538 (0.585)
Peers	3.142*** (0.997)	2.689*** (1.000)	0.686 (0.433)	1.735*** (0.656)
Country		2.389** (1.118)	1.125*** (0.423)	1.662** (0.649)
Video*Country				0.330 (0.834)
Peers*Country				-2.123*** (0.786)
Age	-0.507*** (0.121)	-0.271* (0.157)	-0.048 (0.075)	-0.054 (0.073)
Gender	-2.569*** (0.846)	-2.557*** (0.814)	0.042 (0.367)	-0.032 (0.393)
Siblings	1.146*** (0.404)	1.058*** (0.377)	0.381** (0.168)	0.435** (0.175)
L. Contribution			0.504*** (0.057)	0.491*** (0.056)
L2. Contribution			0.263*** (0.061)	0.262*** (0.060)
L3. Contribution			0.077 (0.047)	0.102** (0.047)
Constant	21.144*** (2.693)	14.622*** (3.790)	2.522 (1.796)	2.262 (1.850)
Observations	864	864	432	432
R-squared	0.169	0.195	0.702	0.709
Number of subjects	144	144	144	144
Period FE	NO	YES	YES	YES

Robust standard errors in parentheses.

***p < 0.01, **p < 0.05, *p < 0.1.

$$C_{ijkt} = \beta_0 + \beta_1 X_i + \beta_2 T_k + \beta_4 S_j + \beta_5 P_t + \beta_3 L.C_{ijkt} + e_{ijk} \quad (1)$$

where C_{ijkt} is the contribution (or being giver/taker), X_{ijk} is a set of demographic controls involving age, gender, and having siblings; T_k is a set of two binary variables equal to 1 if treatment k (Video or Peer) is applied or 0 otherwise. We also include S_j and P_t dummies to capture any unobservable heterogeneity between sessions and among the 6 periods, respectively. S_j is a binary dummy equal to 1 in Kazakhstan and 0 in the UK. We then add $L.C_{ijkt}$ is a set of lags of dependent variable of order 1 to 3, and e_{ijk} is the error term. All regressions run on Stata.

Table 5 presents Baseline estimates.

In column 1, we start with treatments and demographic controls. The results confirm that video treatment has no significant impact, unlike PE which additionally boosts contributions by about 15%. Thus the a priori expectation in treatment 2 can be rejected. This is consistent with our preliminary (non-parametric) findings. Males tend to contribute less than females by about 12%. Along with gender, the number of siblings plays a significant role. Having a sibling increases contributions by 5–6%, suggesting that kinship leads to altruism. However, we have not controlled for hidden differences by country and period. In column 2, we rerun the model adding S_j and P_t fixed effect dummies. Age now becomes less relevant, and the magnitude of PE reduces but otherwise the results are similar to those in column 1. As previously observed, contributions by country differ significantly. Participants from Kazakhstan contributed 2.38 units more than UK participants.

In column 3, we include lags of the dependent variable that improves the model fit significantly but reduces the number of observations. The game has been played 6 times (periods) and the results show there is interdependence of contribution choices between rounds; contribution amount chosen by participants in previous rounds, is highly related to subsequent contributions. The relevance of previous decisions gradually lessens after three rounds. After adding the lag variables, the importance

of treatments and demographic factors disappear, apart from the sibling effect. The differences between UK and Kazakhstan are still significant. We learned previously (Table 1) that contributions at the mean level were as large as 50% between peer groups in Kazakhstan and the UK. Thus, we add interaction terms, in column 4, interacting country variable with treatments, to decompose the impact of treatments for each session. Consequently, the significance of PE returns. PE increased contributions in the UK experiment by 17% and in Kazakhstan by 13% (net effect comes from three coefficients: $1.662 + 1.735 - 2.12 = 1.277$).

The country coefficient is weaker as the interacted terms absorb some of its power. Unlike age and gender, the number of siblings is still significant at 10%, having a younger sister or brother increases contributions by 5% even after adding fixed effects and lags. The results suggest that those participants who grow up in larger families are more generous (environmentally friendlier). The lags until the third order, including it, are significant, then the importance vanishes.

4.6. Baseline logit regressions

We rerun (1) by swapping the dependent variable to “giver”. Results are shown in Table 6.

Since the giver variable is binary (1 if a participant contributes more than or equal to 75% of his/her wealth; 0 otherwise), we use the logit estimator. Table 6 reports the results from columns 1 and 2 with and without interaction terms accordingly. Starting with the significant results, we find that higher contributions in previous rounds increase the probability of being a giver. Further, we find that neither of the treatments is significant, apart from video treatment which increases the log odds of givers (vs non-givers) by 1.2 for Kazakhstan and instead reduces them in the UK experiment. Age and gender are not important factors; while the likelihood of being a giver increases with the number of siblings, it is statistically insignificant.

We also repeat logit regressions using takers (Annex, Table A2). Understanding those who do not wish to contribute most of their wealth

Table 6
Baseline logit results with givers.

VARIABLES	(1)	(2)	(3)	(4)
	Giver	Giver	Taker	Taker
Video	-0.421 (0.354)	-1.046* (0.539)	-0.382 (0.430)	-0.459 (0.555)
Peers	0.398 (0.377)	0.663 (0.541)	-0.247 (0.488)	-0.567 (0.599)
Video*Country		1.233* (0.733)		0.161 (0.900)
Peers*Country		-0.704 (0.750)		0.932 (0.967)
Age	-0.023 (0.061)	-0.017 (0.062)	0.056 (0.065)	0.062 (0.066)
Gender	0.392 (0.318)	0.278 (0.330)	0.359 (0.423)	0.333 (0.428)
Siblings	0.280* (0.168)	0.300* (0.177)	-0.638** (0.269)	-0.694** (0.276)
Country	0.264 (0.392)	0.116 (0.568)	-1.323*** (0.475)	-1.615** (0.691)
L. Contribution	0.221*** (0.036)	0.217*** (0.036)	-0.280*** (0.057)	-0.275*** (0.057)
L2. Contribution	0.124*** (0.039)	0.128*** (0.039)	-0.157*** (0.056)	-0.158*** (0.057)
L3. Contribution	0.100*** (0.037)	0.115*** (0.038)	-0.014 (0.048)	-0.018 (0.049)
Constant	-5.610*** (1.595)	-5.768*** (1.668)	1.969 (1.607)	2.035 (1.630)
Observations	432	432	432	432
Period FE	YES	YES	YES	YES
Pseudo R-squared	0.472	0.484	0.536	0.539

Standard errors in parentheses.

***p < 0.01, **p < 0.05, *p < 0.1.

is as important as understanding those who do. Results with takers in columns 3–4, almost mirror the results with givers in columns 1–2 but with opposite signs. It is important to understand that takers are not givers with less than 75% wealth donated but only those who kept 75% or more of the endowments. Unlike the results with givers, the country variable stays significant at 1% level and negative. Thus, it is safe to suggest that the log odds of being a taker decreases by 1.3–1.6 in Kazakhstan compared to UK. No significant impact of both treatments, not even when the interacted term is added, is observed. From demographic factors, we observe a positive impact of having siblings and the lag of contributions on the reduction of takers.

In summary, Peer nudge has a powerful role to play overall and is statistically significantly powerful, but the information nudge is not consistent with previous literature.

5. Discussion

Our research question focused on what makes students recycle? We ask if nudging behaviour has an effect controlling for different countries. We find that three effects are robust and statistically significant. The first is the PE in line with subjective norms. The second is the country effect where Kazakh students contribute more to recycling, despite the country having a poorer recycling rate, compared to the UK. Significant other characteristics also are important; those with siblings recycle more.

These results are in line with the psychological explanation of recycling behaviour (e.g., Ajzen and Fishbein et al., 1980; Hopper and Nielsen, 1991; Andersson and von Borgstede, 2010). Particularly, social norm, including the PE, is widely used to explain decision-making (e.g., Nyborg et al., 2006; Brekke et al., 2010). While testing PE, individuals were told the highest average obtained in the Base. The result is interesting because it not only emphasizes that individuals will recycle when they observe the same decisions from their peer group; but that peer pressure also exists even if their peers do not know about individual decisions. This finding is congruent with Asch's (1956) studies of normative social influence in which many participants conformed when a sizeable number of others made similar choices.

In TPB, individual behaviour orientation is influenced by three significant external psychological forces: attitude, subjective norms and perceived behavioural control (Ajzen, 1991). We did not directly measure perceived control: the objective was to use TPB as a starting point. Perceived control is often ascribed to locally available facilities which induce recycling capabilities. The expectation would be that the contribution would be lower in countries with low recycling facilities, such as Kazakhstan. However, even the Kazakh Base contribution was almost 25% higher when compared to UK's Base (Table 1). Information nudge and peer nudge were statistically significant and when compared to the Base in Kazakhstan, the contribution increased by 8.6% and 34% respectively. The effect of the treatments widens the country gap. The information nudge shows that Kazakh students responded by increasing contributions 32.88% over their UK counterparts while the PE induced a powerful 53% increase.

Some of the reasons for the above results could be (in the absence of a survey) explained by the participant characteristics. We observe (Table 3) that almost 57% of the Kazakhstan students were from natural sciences in contrast to 8.33% from the UK. This was in sharp contrast to most UK students, who were from a business background. Such inhabitants who are studying natural science desire to see powerful changes from recycling, compared to others from the UK who may take institutional recycling for granted. Kazakhstan is an economy in transition, and market liberalisation has arrived relatively recently while the UK has stressed on independent decision-making for a longer period. It may be that Kazakhstani students are more integrated with the idea of bringing change in their neighbourhoods and this may be strictly enforced. Sarbassov et al. (2019) found in a survey of 3281 household respondents, conducted in Nur Sultan in Kazakhstan, in 2018, that 24% of respondents were already sorting household solid waste despite the

absence of a separation system at the source. Another possible reason could be that Kazakh social homogeneity (Bouma et al., 2008) acts as a proxy for trust, thus inducing pride in surroundings. The UK, in contrast, comprises of a mixture: local, other European and international students. Some may feel detached from the environment and/or may find the recycling practices (such as labelling) baffling. The results suggest that recycling policy, in general, may be nudged by increased environment focused education. Information nudges may further help in changing attitudes.

Peer norms entail that, even if participants were unwilling, the perceived potential criticism from peers acts as a coercive force that changes behaviour intention. This is demonstrated in our study (Tables 1 and 5). In Table 5, the PE is statistically significant in all column specifications except 3. We learned previously (Table 1) that contributions at the mean level are as large as 52% (15.45 vs 10.10, between peers' groups in Kazakhstan and the UK). We add interaction terms (in column 4), interacting the country variable with treatments. With interacted terms, the statistical significance of PE returns. PE nudged UK up by 17% and in Kazakhstan by 13% (net effect comes from three coefficients $1.662 + 1.735 - 2.12 = 1.277$). Even where independent thinking is strongly emphasised, decision-making can be influenced by PE. This result suggests that policymakers should keep people informed about the recycling statistics and successful initiatives.

Individuals can be divided into givers, takers and matchers based on their attitudes towards altruistic behaviour in organisations (Grant, 2013). Givers contribute to others without quid pro quo, helping, offering knowledge, or making valuable introductions. Takers, in contrast, are free riders while carefully guarding their expertise and time. These results suggest intrinsic motivation is a powerful determinant, independent of external factors. In the context of public choice games, takers are free riders. In our study, we classified those who contributed 75% or more of their endowment as givers; those who gave less than 25%, as takers. There were 46 subjects from the total population of 144 (36%) who were givers and 21 from the total population who were takers, thus indicating that free riders were a tiny minority of less than 15%. We find, consistent with the country effect, that Kazakh students comprise a large percentage of the total givers (32 from the total 46). However, it appears that all students could be coaxed into becoming givers by using peer nudges (Table 2, panels A and B). Thus, from a policy perspective, using peer norms to influence recycling altruism may be possible.

The effect of the nudge is diminished when personal characteristics are considered (Table 6) - the concept of subjective norms includes not only peers but also values acquired from ethnicity, culture, and family kin. In this context, the students with siblings were givers (Tables 5 and 6), suggesting that learning to share in families might influence recycling. Policy resource implications suggest subjects may be influencers. Preliminary results from Table 4 suggest that female students contribute more than their male counterparts and younger people contribute more than their elders (Table 5); the inclusion of lags weakens this. The gender effect is consistent with other studies (Babcock et al., 2018) suggesting that policy actions are required to stimulate male volunteering.

6. Conclusions

Motivated by urgent calls to control waste, we explore what influences the behaviour of UK and Kazakh students in universities, through an experimental public choice game. We contribute to extant studies by employing a novel methodology.

Students are invited to notionally contribute to a public project in a laboratory setting. Two nudges (information and peer knowledge) are tested to ascertain if social norms can induce responses from a Baseline. We explore whether a country effect (culture) is influential. Altruism is studied through the scrutiny of contributions and participant characteristics.

Peer nudge has a powerful role to play overall and is statistically

significantly powerful, but the information nudge is not consistent with previous literature. We find a significant country effect; Kazakh students contribute more. Policy makers should, hence, focus on peer influences to encourage recycling.

The results from Kazakhstan suggest there may be good environmental practices in emerging economies emanating from culture. Country deviations could be based on multifarious reasons: the students' area of study (Natural Sciences, Kazakhstan) and the heterogeneity of the population (UK). This could not be explored further, which is a limitation of the study. Further research could incorporate a follow-on survey exploring responses, after the experiments. Furthermore, the scope of the study could include other demographics to explore the impact on information and peer nudges. The results of the experiments show that environmental education could stimulate positive normative social influence.

CRedit authorship contribution statement

Geeta Lakshmi: Conceptualization, Framing, Analysis, Writing up,

Writing – original draft, Formal analysis, Project management, Supervision, Implementation discussion, UK and Kazakhstan. **Kim Nguyen:** Framing, Methodology, Pilot Testing, Implementation UK and Kazakhstan. **Arman Mazhikeyev:** Analysis, Formal analysis, Resources, Translation, Software, Implementation discussion Kazakhstan. **Dieu Hack-Polay:** Reviewing and editing, Writing – review & editing, Implementation UK, Verification. **Zhibek Anafievna:** Resources, and Implementation of experiment Kazakhstan.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jclepro.2022.134164>.

Annex.

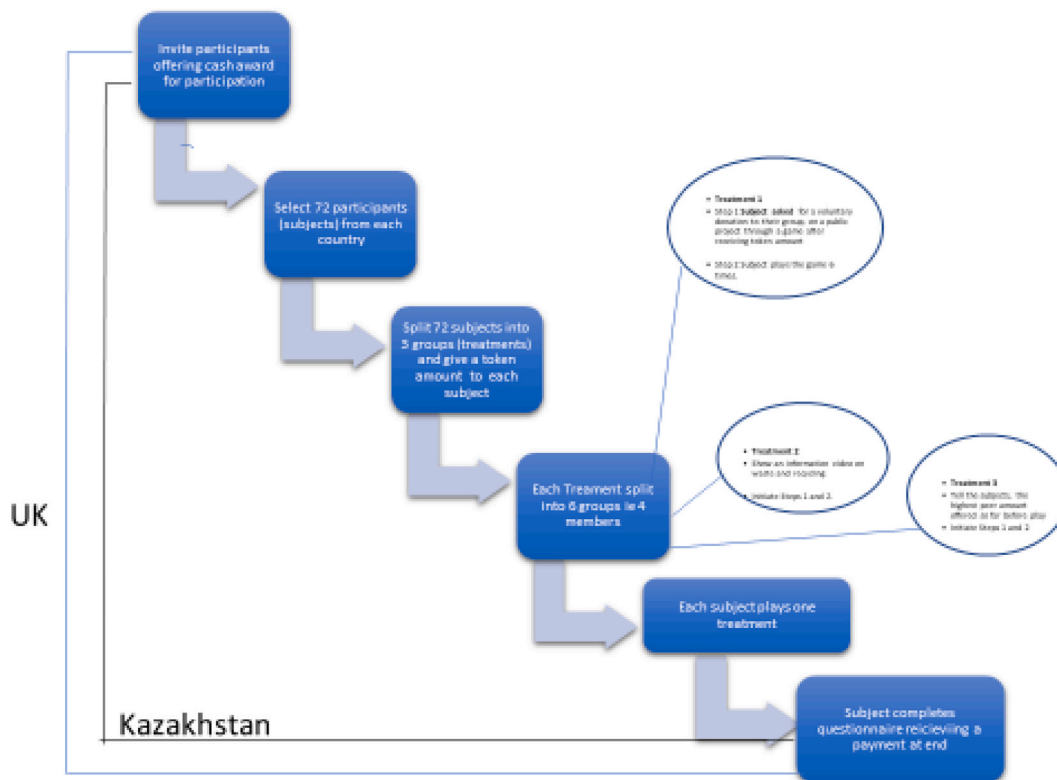


Figure A.1. Steps in the Experiments.

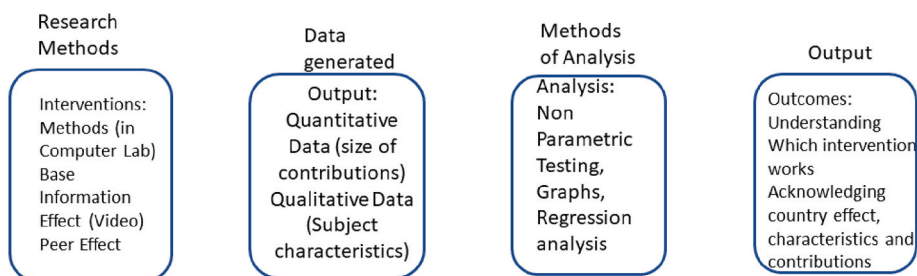


Figure A.2. Framework of Methodology.

Table A1 Description of Variables

Variable	Description	Reference
Siblings	The number of siblings a participant has.	
Major (Natural Science)	Natural Science/Social Science	
Nationality	Western and the rest of the world	
Risk (General; Finance; Driving; Faith; Health)	The willingness to take risk in general situations/finance/driving/faith/health. The measure is 0–10, where 0 means no willingness to take risk and 10 is taking the maximum risk.	Dohmen et al. (2011)
Risk (Holt and Laury, 2002)	The Holt and Laury (2002) experiment, which is used to measure risk preference. The measure is from switching point 0 to switching point 10, in which, 0–3 means risk-loving; 4 means risk-neutral and 5–10 means risk-aversion.	Holt and Laury (2002)
Satisfaction	The level of satisfaction with the scale from 0 to 10, in which 0 indicates no satisfaction and 10 reflects maximum satisfactory level.	Life Satisfaction Index
Ladder	Participants are asked to indicate which ladder step they think they stand at the present time. The top step is 10 and the bottom step is 0.	Gallup World Poll (Bjørnskov, 2010)
Financial Management	Participants are asked to indicate their financial management skill. We use a 5-point Likert scale here.	
Big Five Personality Traits	The measurement for big five personality traits, including Extraversion, Agreeableness, Conscientiousness, Neuroticism and Openness.	Benet-Martínez and John (1998)

Table A2 Baseline Logit Results with Takers

	(1)	(2)	(3)	(4)
VARIABLES	Taker	Taker	Taker	Taker
Country	-1.659*** (0.585)	-1.671*** (0.587)	-1.622** (0.686)	-3.261** (1.275)
Video		-0.516 (0.593)	-0.514 (0.592)	-0.262 (0.668)
Peers		-0.516 (0.593)	-0.298 (1.715)	-2.332 (1.965)
Peers_kz			-0.179 (1.329)	1.967 (1.685)
Age				0.021 (0.103)
Gender				1.203* (0.645)
Major				1.959* (1.108)
Nationality				-0.287 (0.696)
Younger siblings				-1.003** (0.461)
Constant	0.485 (0.757)	0.825 (0.827)	0.763 (0.942)	1.540 (2.995)

Standard errors in parentheses.
 ***p < 0.01, **p < 0.05, *p < 0.1.

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