PANOECONOMICUS, 2024, Vol. 71, Issue 3, pp. 323-344
Received: 01 August 2021; Accepted: 11 June 2022.

UDC 364-11:519.22
https://doi.org/10.2298/PAN210801018O
Original scientific paper

Iana Okhrimenko
Lazarski University,
Poland
iana.okhrimenko@lazarski.pl
ORCID: https://orcid.org/0000-0002-8121-0733

The Attribution of Causality, Perception of Responsibility, and Preferred Generic Means of Life Distribution

Summary: The attribution of causality, a central concept in human cognition theory, is the principal instrument for investigating functional links between events and phenomena. Although the links between causality and moral responsibility are commonly recognized, the scope of studies analysing the practical implications of causality attribution is minimal. This study examines the effect of causality perception on the desired distribution of the generic means of life by utilising thought experiment data collection methodology and non-parametric statistical analysis. The results indicate that: (i) causality perception affects the desired distribution, and (ii) individuals show no tendency to modify their perception of causality.

Keywords: Causality, Bayesian model of cognition, Social distribution.

JEL: A12, B55, C83.

Causality is one of the key concepts in human cognition. We instantly use our knowledge about causal links in order to make judgments about the world and establish new causal links, as this is an inevitable part of learning and analysis (Judea Pearl 2000; Joshua B. Tenenbaum et al. 2011). However, as most cognitive processes, establishing causal links is biased (David T. Miller and Michael Ross 1975; Caren A. Frosch and P. N. Johnson-Laird 2011; Helena Matute et al. 2015). Consequently, we often make unjustified and simplified conclusions, as discussed in this paper.

The perception of causality does not solely affect how we develop knowledge about the world. We also tend to transform the perception of causal links or positive statements into the perception of what the situation should look like or normative statements. The perception of causal links shapes the rules and patterns according to which we cooperate with others, sometimes resulting in mistreatment, discrimination, and stigmatization. In 1982, Southern Californian scientists named the virus causing immune deficiency (HIV) a gay-related immune deficiency (or GRID) due to the common belief that its only transmission was through homosexual contacts (Centers for Disease Control and Prevention 1982). In the last three decades, virologists have discovered other channels of HIV transmission. Nevertheless, nowadays, gays suffer from the HIV-related stigma much more compared to other patients (Charles A. Emlet et al.

2017), since they are presumed to bear greater "causal responsibility" for their disease. We tend to modify our causality perception in accordance with our beliefs regarding social and moral norms in order to justify our attitudes (Mark D. Alicke 1992). At the same time, causal weight is commonly recognized as the determinant of responsibility (Sara Bernstein 2017). The resulting vicious circle serves as the perfect support for discrimination in terms of social distribution.

There are numerous studies devoted to how individuals perceive justice based on causal links in their minds (Alicke 1992; Joshua Knobe 2005; Knobe and Ben Fraser 2008; Christopher Hitchcock and Knobe 2009; Alicke, David Rose, and Dori Bloom 2014; Jonathan F. Kominsky et al. 2015). Nevertheless, none of the aforementioned studies examined the implications of the causality biases on the preferred social distribution. Moreover, although mainstream economics provides plenty of evidence of other-regarding preferences (Samuel Bowles and Herbert Gintis 2000; Roland Bénabou and Efe A. Ok 2001; James Andreoni and John Miller 2002; Christopher Dawes et al. 2007), there is extremely limited evidence regarding how agents make decisions about social distribution in situations when their utility is not affected directly. This study attempts to fill the gap by analysing: (i) the effect of causality perception on the social distribution preferences; (ii) the transformation of causal links in human mind under new information, and (iii) the role of prior beliefs in the process of transforming causal links into judgments about justice and preferred social distribution. The importance of the research is justified by the fact that mainstream economics neglects the process of social preferences formation, treating them as static and exogenously designed mechanisms.

The structure of the study is as follows. Section 1 presents the theoretical background of the research, including the most common causality biases, approaches toward learning causality, perception of probabilistic and deterministic causality, and effect of causality perception on the judgments about justice. Section 2 contains the description of the research methodology with emphasis on data collection methods, analytical methods, and research hypotheses. Section 3 displays and discusses the results and their interpretation. Section 4 concludes the paper.

1. Literature Review

1.1 The Illusion of Causality and Causality Learning

As Patricia W. Cheng and Mark J. Buehner (2005) discuss, people generally tend to assume causal relationships and create causal models. However, they frequently fail to establish causal links correctly. The illusion of causality is a cognitive bias that occurs "when people develop the belief that there is a causal connection between two events that are actually unrelated" (Matute et al. 2015), and which has been a subject of numerous laboratory studies (see, for instance, Ellen J. Langer 1975; David R. Shanks and Anthony Dickinson 1988; Shu-Fang Kao and Edward A. Wasserman 1993; Matute 1995, 1996; Gustaf Gredeback, Anders Winman, and Peter Juslin 2000; Buehner, Cheng, and Debora Clifford 2003; Anna Coenen, Bob Rehder, and Todd M. Gorecki 2015). Although human beings tend to think in terms of causal models, they possess an imperfect ability to design such models. The common belief is that the main reason

behind the illusion of causality is the inefficient process of causality learning; subsequently, this bias can be eliminated by introducing proper learning techniques and methods (Matute et al. 2015). Two fundamental approaches toward learning causality in psychology and cognitive sciences are distinguishable. As Michael R. Waldmann, York Hagmayer, and Aaron P. Blaisdell (2006) discuss, the traditional view assumes that causal links are derived based on the observed covariations between the events, "similar to Pavlov's dog learning to predict food when it hears a tone (i.e. classical conditioning), or to a rat's learning that a lever press produces food (i.e. instrumental conditioning), we learn about causal relations" (p. 308).

Waldmann, Hagmayer, and Blaisdell (2006) criticize the covariation paradigm, mentioning that it fails to explain the fact that individuals distinguish between the causal links and "spurious statistical relations", such as barometer indicators and weather. Although there is a perfect covariation between these events, the former determines the latter cannot be stated. Instead, both of these events are defined by atmospheric pressure. Waldmann, Hagmayer, and Blaisdell (2006) argue that individuals assess causalities by elaborating "causal networks", i.e. schemes of causal links designed based on the experience and that affect the pattern of further causal learning. The causal networks can be designed and modified based on both the observed ("seeing") and interventional interferences ("doing"). Such a framework is in line with the Bayesian model of cognition (although this is not mentioned in Waldmann, Hagmayer, and Blaisdell 2006).

Bayesian models of cognition have become popular in the field of psychology and cognitive sciences relatively recently, with plenty of support (Nick Chater et al. 2011; Noah D. Goodman, Tomer D. Ullman, and Joshua B. Tenenbaum 2011; Thomas L. Griffiths et al. 2012) and significant criticism (Matt Jones and Bradley C. Love 2011; Gary F. Marcus and Ernest Davis 2013). As Sean Tauber et al. (2017) describe, the Bayesian model of cognition assumes that individuals make judgments by choosing the correct hypothesis out of all the possible hypotheses H. All the individuals possess prior beliefs about the world described by the prior distribution function $P(h)$. Through observing data x, they transform their prior beliefs into the posterior beliefs described by the function $P(h|x)$, as Bayes rule (Tauber et al. 2017, p. 5) describes:

$$P(h|x) = \frac{P(x|h)P(h|\mathrm{H})}{\sum_{h' \epsilon \mathrm{H}} P(x|h')P(h'|\mathrm{H})}.$$

From this perspective, causal networks described by Waldmann, Hagmayer, and Blaisdell (2006) might serve as the prior distribution and simplify the process of new causal links investigation. Goodman, Ullman, and Tenenbaum (2011) reinforce a similar idea by analysing simulations of causality learning within the framework of hierarchical Bayesian models. The authors show "that the correct abstract theory results in quicker learning of causal structure than having no theory": incorporating objectively correct abstract knowledge (i.e. prior distribution) makes the process of causality learning more efficient than in the case of uniform prior distribution.

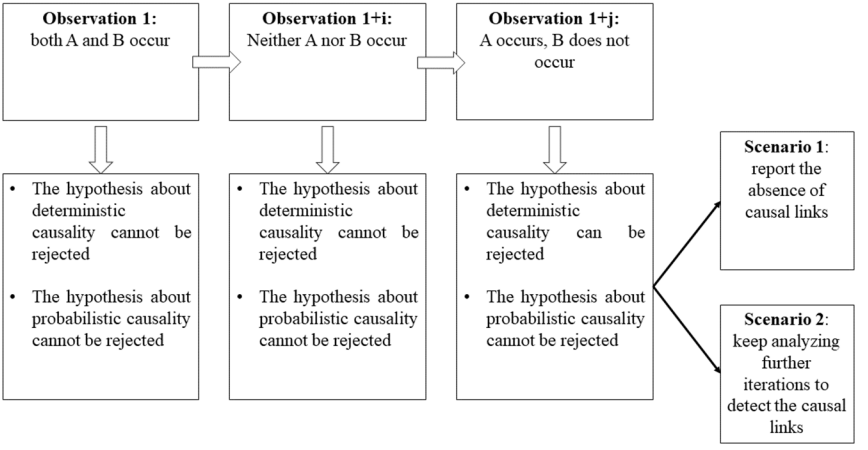
Nevertheless, the human mind does not possess a perfect analytical capacity and objectively correct prior distributions. Although our experience and knowledge allow us to speed up the process of causality investigation, we are strongly affected by our

beliefs and preferences serving as prior distributions (or causal networks). Rational individuals should adjust and transform their causality perception under new information inconsistent with their prior beliefs. However, in the light of human cognitive processes' imperfections, the question of whether Bayesian updating indeed takes place in our mind is subject to further analysis.

1.2 Deterministic versus Probabilistic Causality in Theory and the Human Mind

The dichotomy of deterministic and probabilistic causality dichotomy has a long history, as Peter A. White (1990) mentions. Deterministic causality implies that the occurrence of event A is both a necessary and sufficient condition for occurrence of event B. Under probabilistic causality, event A facilitates the occurrence of event B; at the same time, event B occurrence if event A occurs is uncertain (Hitchcock 2001).

Probabilistic and deterministic causality is usually discussed from the perceptive of the philosophy of science, rarely provoking the interest of behavioural economists and psychologists. However, the reader would probably agree that we deal mostly with probabilistic causal links daily. For instance, students with a high level of intelligence are more likely to have high marks; at the same time, there is a range of other statistically significant determinants of school educational performance; further, a healthy lifestyle increases the probability of longer life expectancy, but cannot guarantee it because of numerous lethal risks, and so forth.



Source: Author's elaboration based on Frosch and Johnson-Laird (2011).

Figure 1 Scheme of the Decision-Making Process in the Experiment Revealing Whether Individuals Perceive Causality as a Deterministic or Probabilistic Concept

Nevertheless, individuals tend to perceive causal links as deterministic rather than causal ones, according to Frosch and Johnson-Laird (2011). They analyse the perception of causality based on the range of experiments. For most participants, a single case when event A did not cause event B was enough to conclude without further investigations that there are no causal links between A and B. Therefore, Frosch and

Johnson-Laird (2011) conclude that individuals perceive causality as deterministic rather than a probabilistic concept. Christian C. Luhmann and Woo-Kyoung Ahn (2005), as well as Laura E. Schulz and Jessica Sommerville (2006), reinforce the same idea (yet do not provide such an extensive analysis).

One of the possible reasons behind this phenomenon (although the original paper did not concentrate on it) is that detecting probabilistic causal links requires analysing a greater number of iterations (and, subsequently, making more mental effort) in comparison to deterministic causal links. Figure 1 presents a simplified scheme of detecting probabilistic and deterministic causal links based on the experimental framework of Frosch and Johnson-Laird (2011). In a situation when one is certain about the absence of deterministic causal links, rejecting the hypothesis about probabilistic causality would require further investigation and analysis: scenario 2 implies a higher mental cost. Therefore, the participants prefer to stop an experiment at the stage of deterministic causal links detection, giving up on defining probabilistic causal links.

1.3 The Perception of Causal Links and Judgments on Responsibility

The simple intuition suggests a link between the perception of causal links and responsibility attribution. Bernstein (2017) reinforces this idea, treating "causal contribution" as a determinant of responsibility: "... you are only morally responsible for what you cause. One thing that matters for the degree to which you are morally responsible for an outcome is your precise causal contribution to the outcome-intuitively, 'how much' you contribute to the outcome's occurrence" (Bernstein 2017, p. 165). The works discussed above deal mainly with the normative analysis of the links between causality and responsibility. However, since current research concentrates on the practical decision-making process, it is more important to analyse whether humans perceive "causal contribution" as the determinant of responsibility.

The traditionalist approach suggests that individuals evaluate moral responsibility similarly to philosophers, stating that an actor is subject to moral responsibility if there is a causal link between the act and the undesired outcome (see Kelly G. Shaver 1985; Bernard Weiner 1995; Steven A. Sloman, Philip M. Fernbach, and Scott Ewing 2009). In other words, establishing causal links precedes making judgments about responsibility. The alternative point of view suggests that causality perception is biased by moral evaluation: making judgments on responsibility is a primary chain in the link, while establishing causality is secondary. For instance, Alicke (1992) points out that people recognize an action as a primary cause of undesirable outcomes more frequently when the actors' intentions are immoral. The range of studies confirms the idea that moral judgments are the primary factor preceding establishing causal links (Knobe 2005; Knobe and Fraser 2008; Hitchcock and Knobe 2009; Alicke, Rose, and Bloom 2014; Kominsky et al. 2015), although the proposed mental mechanisms might vary.

Besides the causal weight of the act and its consistency with moral and social norms, the notation of avoidability or control is crucial to assess the degree of responsibility. Charles L. Stevenson (1938) understood avoidability as the possibility of making a decision that would not lead to the undesired outcome. More recent studies reinforce that control is one of the critical factors determining the attribution of

responsibility (see Frank D. Fincham and Joseph M. Jaspars 1980; Shaver 1985; Lee V. Hamilton and Joseph Sanders 1992; Barry R. Schlenker et al. 1994; Weiner 1995). Therefore, it is possible to distinguish between three key factors shaping the perception of responsibility, namely, the causal weight of the act, its consistency with social and moral norms, and the degree of the actor's control (i.e. the possibility of making the alternative decision, which does not lead to the undesired outcome). Nevertheless, opinion regarding the functional form of causality attribution of responsibility is not uniform,

1.4 The Perception of Justice and Preferred Social Distribution

The perception of justice (i.e. people's subjective opinion on what is just or unjust and what principles define such an opinion) is an essential factor in the decision-making process. Justice may be defined as a situation in which people get what they are entitled to because of their attributes (social status, actions, and achievements) (Allen Buchanan and Debora Mathieu 1986; Ronald L. Cohen 1986; Gerold Mikula 2001). Responsibility (understood as an obligation of the party to bear costs resulting from its action) and justice are closely related, yet not identical concepts. Leo Montada (1991) mentions that "the very concept of justice implies that some agent or agency is responsible for experienced losses and hardships" (p. 14). Simply, responsibility attribution is one of the key factors determining the perception of justice.

The perception of justice should shape the preferred distribution of public goods (this statement arises from the definition of justice). However, reinforcing it with some empirical evidence would be challenging. The effect of justice/fairness considerations on the social preferences was addressed in numerous studies directly or indirectly (see, for instance, Bowles and Gintis 2000; Bénabou and Ok 2001; Andreoni and Miller 2002; Dawes et al. 2007). Nevertheless, noteworthy is that the nature of justice/fairness considerations analysed in mainstream economics is quite ambiguous. John C. Harsanyi (1953) underlined the impossibility of drawing the borderline between the social welfare considerations and self-interest; even inequality-aversion might be implied by the risk-aversion and awareness on the possibility of descending the social ladder. Subsequently, there are very few pieces of evidence regarding how agents make decisions about social distribution in situations when their decisions have no straightforward effect on their utility.

2. Methodological Approach

2.1 General Framework

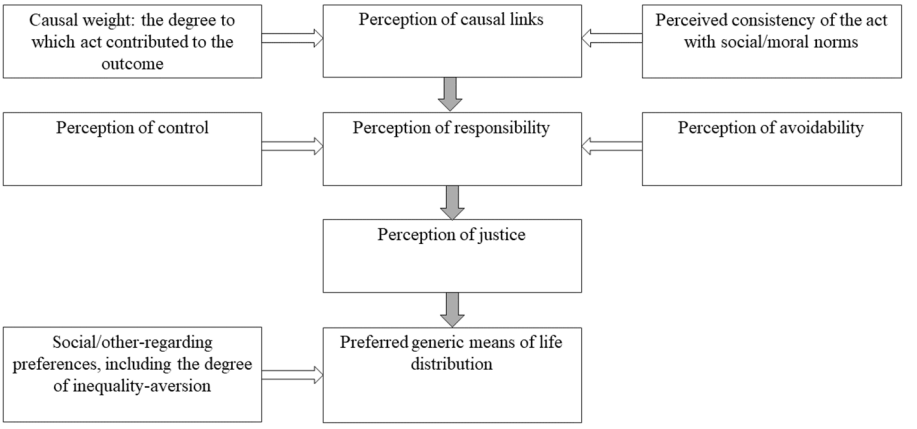
The perception of causal links affects the perception of responsibility since "causal contribution" is one of the critical determinants of responsibility. Individuals treat justice as a situation in which a responsible party bears the cost of an undesired outcome. Therefore, hypothetically, there should be a strong link between the way individuals perceive causal links and their preferences regarding social distribution. Seemingly theoretical, this hypothesis can be operationalized using the thought experiment method.

A thought experiment is a research method utilizing assumptions about reality and logic in order to analyse possible consequences and implications (Roy A. Sorensen 1992). Although thought experiments are applied in many fields, the requirements for their settings are different for social and natural sciences. From the perspective of natural scientists, a well-designed thought experiment should be based on axioms and formal logic. In contrast, social scientists are interested instead in the mental processes taking place in the human mind when following an experiment's storytelling. Activating respondents' decision-making processes plays a crucial role since "engagement of the cognitive mechanisms associated with vivid imagining may lead a subject to reverse a prior commitment, selecting as preferable the option previously rejected and shunning the option previously embraced" (Tamar S. Gendler 2007, p. 69). In other words, a well-designed social scientific experiment should allow the respondent to "walk in the shoes" of the person described in the experiment.

Most studies devoted to the determinants of justice perception solely utilize retrospective analysis: the respondents provide an evaluation of the real or hypothetical situation without further analysis (see Alicke 1992; Knobe 2005). The advantage of such a straightforward approach is the lack of any unobservable effects and flexibility in terms of the problem set. Nevertheless, retrospective problem analysis does not provide any insight regarding the way human perception of reality affects the process of decision-making. The present study, in contrast, attempted to analyse the implications of the causality perception, which makes thought experiments a more appropriate data collection tool.

The participants had to decide regarding the distribution of public health care funds between two groups of people in a hospital specialised in treating all cancer types. The patients of the first group were former smokers, while patients from the second group never smoked. These groups were of equal size, and no additional information was provided. The respondents were asked to imagine that their opinion would be considered when dividing public funds between two groups of patients. Their task was to assign a proportion of funds to the former smokers and the rest assigned to the group of patients who never smoked. The notion of "former smokers" was introduced in order to prevent respondents from making decisions on a rational utilitarian basis. The patients, who still smoke, are more resistant to cancer treatment. Therefore, a utilitarian social planner would assign funds to the patients who never smoked in order to maximize aggregate utility. To avoid possible bias, the storytelling of the experiment included solely former smokers.

Information provided in the problem set was insufficient for establishing proper causal links. Nevertheless, the causal link between smoking and cancer in the human mind is strong and instantly reinforced. As human beings: (i) naturally tend to assume causal links and (ii) mainly solely consider deterministic causality, they might ignore imperfect information condition, assuming that former smokers have cancer because of their own choices. Subsequently, one can observe how the perception of causality affects the perception of justice by analysing the distribution of funds between two groups of patients. The proposed scheme of decision-making is presented in Figure 2.



Source: Author's elaboration.

Figure 2 The Proposed Scheme of Transforming Causality Perception into the Preferred Social Distribution

2.2 Experimental Study Design and Research Hypotheses

The experiment was conducted in the form of an asynchronous online survey; in total, 106 students from economic, management, and international relations faculties at the University of Warsaw and Lazarski University in Warsaw participated. Most of students came from Poland and Eastern Europe. The responses were collected in the period between March 2019 and June 2022. The age of the participants was between 17 and 38. The proportions of females and males were roughly equal. Approximately 30% of respondents reported themselves to be current or former smokers.

Since the problems the participants were asked to resolve were ethically sensitive, the participants were asked to provide their nicknames instead of their actual names and emails for the sake of accountability. During the thought experiment, the participants were asked to imagine themselves in hypothetical situations, acting in the same way as they would in real life.

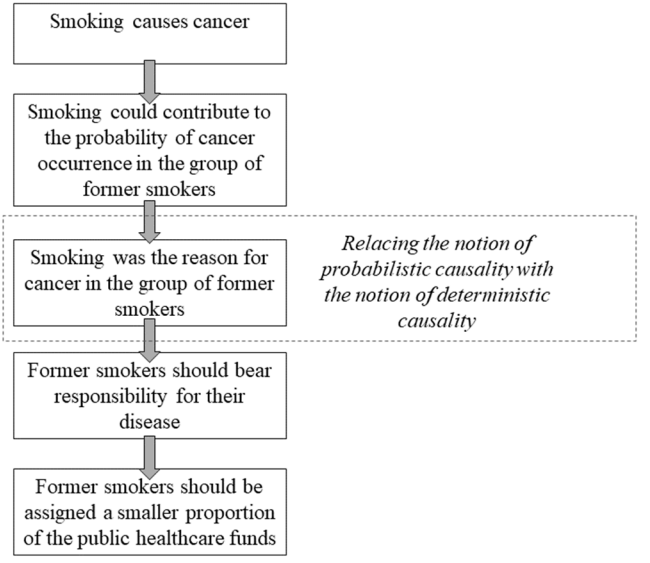
In the first round, the participants were asked to divide public health care funds between two groups of patients who had cancer; the groups were of equal size. The patients from the first group were former smokers, while patients from the second group never smoked (see scans of the experiment in Appendix). No additional information about the patients was provided; therefore, it is possible that patients, who never smoked, exposed themselves voluntarily to other cancer risks. The participants, who realize their imperfect knowledge, should assign equal proportions of funds to the groups of former smokers and non-smokers, based on the Bayesian prior. Additionally, participants, who do not treat responsibility as the factor of just distribution, would also split the funds equally.

If the participants decide to assign equal shares of public funds to groups of former smokers and non-smokers in round 1, then any of the following explanations might be correct:

(i) The participants are conscious of their imperfect knowledge;
(ii) The participants do not treat responsibility as the principle of deciding on just social distribution.

However, if the participants decide to assign the major share of funds to the group of non-smokers, then both the following conditions are met:

(i) The participants create a wrong causal link between smoking and cancer (see Figure 3), replacing probabilistic causal links with deterministic causal links;
(ii) Since perceived causal links affect judgments about responsibility, the participants conclude that former smokers are responsible for their disease. Therefore, the participants assign the major proportion of funds to non-smokers (see Figure 3).



Source: Author's elaboration.

Figure 3 The Proposed Scheme of Decision-Making of the Participants Assigning the Major Proportion of Funds to the Group of Non-Smokers

In the second round, the participants were asked to assess the approximate proportion of people who have cancer because of smoking. This measure was used as the proxy for the degree to which former smokers facilitated cancer occurrence in the group of former smokers. As the causal weight of the act is one of the responsibility determinants, it is hypothesized that the subjective estimated probability of having cancer because of smoking ($P(cancer|smoking)$) positively affects the probability of assigning the group of former smokers less than 50% of the public health care funds.

In the third round, the participants were shown extractions from the research on cancer determinants. These extracts prove that smoking is not the single possible cause of cancer, as there are numerous factors contributing to cancer development (Elmer

Huerta and Nathan Grey 2009; American Cancer Society 2018). The participants were asked to revise their decision made in the first round. Realizing the lack of a deterministic causal link between smoking and cancer should theoretically break the causal link between smoking and cancer in the former smokers' group. If participants assign the same proportion of public funds to the group of former smokers in the second round, one would be unable to come to a reliable conclusion concerning the effects of causal models modification since there are two possible explanations:

(i) The participants are unable to modify their perception of causal links in the light of new information;
(ii) The participants do not treat perceived responsibility as the principle of deciding on social distribution.

However, if the distribution of funds in round 3 is closer to the prior than in round 1, then both of the following conditions are met:

(i) The participants modify their perception of causal links in the light of new information, realizing that smoking is not a single determinant of cancer, and they cannot define deterministic causal links based on the available information;
(ii) The participants revise their perception of the relative responsibility of groups of former smokers and patients who never smoked, modifying the preferred social distribution choice.

During the final rounds, the participants were asked about their age, gender, and whether they are smokers or former smokers.

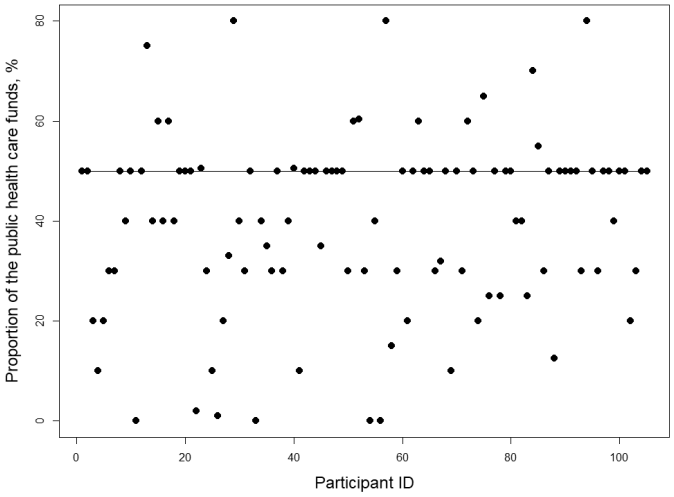
3. Conducting Research and Discussing Results

As discussed earlier, information displayed to the participants in the first round of the experiment is not sufficient for making any judgements about causality and, subsequently, about responsibility (provided that individuals assign responsibility based on the objective causal weights). In such a situation, individuals should split the public funds equally between the groups of former smokers and non-smokers, in line with the Bayesian prior. Figure 4 and Table 1 summarize the distribution of the public health care funds in the first round of the experiment; one should reject the null hypothesis about the prior distribution in favour of the alternative hypothesis, which states that the proportion of funds assigned to the former smokers groups is smaller than specified by the prior distribution. In other words, the participants designed incorrect causal links between smoking and cancer, and their perception of causality shaped their judgments on responsibility, justice, and preferred social distribution.

Table 1 The Results of the Non-Parametric One-Tailed Wilcoxon Rank Sum Test for Public Health Care Funds Assigned to the Former Smokers Group in the First Round of the Experiment (n = 105)

Null hypothesis	The proportion of funds assigned to the former smokers group is equal to the prior distribution
Alternative hypothesis	The proportion of funds assigned to the former smokers group is smaller than the prior distribution
p-value	$p < 0.01$

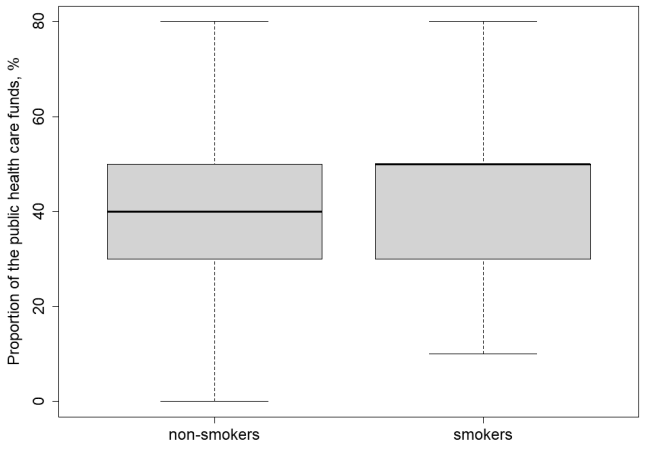
Source: Author's elaboration.



Source: Author's elaboration.

Figure 4 Distribution of the Proportion of Public Health Care Funds Assigned to the Former Smokers Group in the First Round of the Experiment (n = 105)

Although this observation is not entirely relevant to the objectives of the present study, interestingly, respondents who smoke or used to smoke assigned a higher proportion of public healthcare funds to the group of former smokers in comparison to the respondents, who have never smoked; nevertheless, this difference is not statistically significant (see Figure 5 and Table 2).



Source: Author's elaboration.

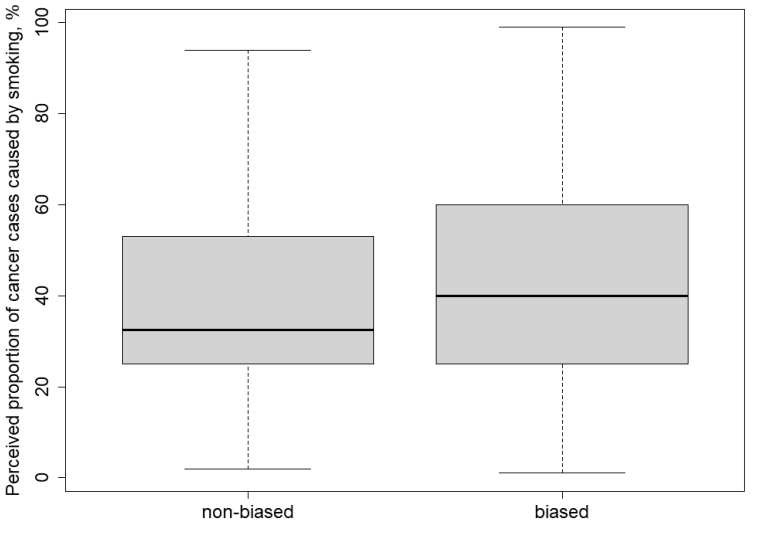
Figure 5 Boxplots of Proportions of Public Health Care Funds Assigned to the Former Smokers Groups in the First Round of the Experiment by the Respondents Who Never Smoked (Non-Smokers, n = 75), and Respondents Who Smoke or Used to Smoke (Smokers, n = 30)

Table 2 The Results of the Non-Parametric One-Tailed Wilcoxon Rank Sum Test for the Difference between the Proportions of Public Health Care Funds Assigned to the Former Smokers among the Groups of Respondents Who Have Never Smoked or Smoke/Used to Smoke (n = 105)

Null hypothesis	The proportions of public healthcare funds assigned to the former smokers group are identical among the respondents who have never smoked and respondents who smoke or used to smoke.
Alternative hypothesis	The proportion of public healthcare funds assigned to the former smokers group by respondents who smoke or used to smoke is greater than the respective proportion assigned by the group of respondents who never smoked.
p-value	0.1458

Source: Author's elaboration.

After the first round of the experiment, the participants were asked to assess the approximate proportion of people suffering from cancer because of smoking. The hypothesis about the positive effect of the perceived causal weight of smoking on the degree of responsibility has been tested based on the Wilcoxon signed-rank non-parametric test output (see Figure 6 and Table 3). The variable of interest (smoker-biased) takes the value of 1 if the proportion of funds assigned to the former smokers group in the first round is smaller than prior would predict, and the value of 0, otherwise (the variable indicates whether the respondent discriminated or did not discriminate against the former smokers). As Figure 6 demonstrates, respondents discriminating against the smokers report a higher perceived probability of cancer caused by smoking.



Source: Author's elaboration.

Figure 6 Boxplots of Perceived Probability of Cancer Caused by Smoking among the Groups of Respondents Who Did Not Discriminate (Non-Biased, n = 54) and Discriminated (Biased, n = 51) against the Smokers during the First Round of the Experiment

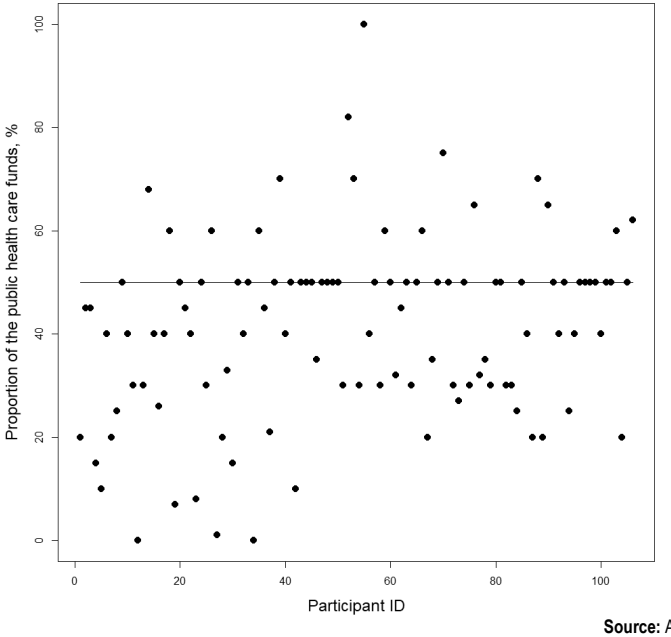
The results of the Wilcoxon rank sum test presented in Table 3 also indicate the links between the perceived probability of cancer caused by smoking and the probability of discriminating against the smokers since the null hypothesis can be rejected at the 5% significance level.

Table 3 The Results of the Non-Parametric One-Tailed Wilcoxon Rank Sum Test for the Difference between the Perceived Probability of Cancer Caused by Smoking among the Groups of Respondents Who Discriminated and Did Not Discriminate against Former Smokers in the First Round of the Experiment (n = 105)

Null hypothesis	The perceived probability of cancer caused by smoking is identical among the respondents discriminating and not discriminating against the smokers in the first round
Alternative hypothesis	The respondents discriminating against the former smokers in the first round report on the higher perceived probability of cancer caused by smoking in comparison to respondents who did not discriminate against the smokers in the first round
p-value	0.04984

Source: Author's elaboration.

In the third round, the participants were presented with several extractions from studies devoted to the various determinants of cancer. If individuals indeed update their causality perception in the light of new information inconsistent with the prior beliefs, the distribution of the public health care funds should be closer to the prior in the third round. Figure 7 and Table 4 prove that the distribution of the health care funds is still lower than that of the prior.



Source: Author's elaboration.

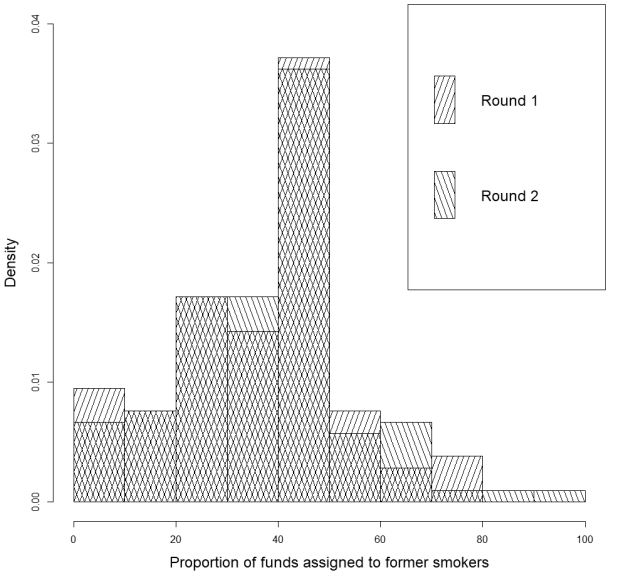
Figure 7 Distribution of the Proportion of Public Health Care Funds Assigned to the Former Smokers Group in the Third Round of the Experiment (n = 105)

Table 4 The Results of the Non-Parametric One-Tailed Wilcoxon Rank Sum Test for Public Health Care Funds Assigned to the Former Smokers Group in the Third Round of the Experiment (n = 105)

Null hypothesis	The proportion of funds assigned to the former smokers group is equal to the prior distribution
Alternative hypothesis	The proportion of funds assigned to the former smokers group is smaller than the prior distribution
p-value	$p < 0.01$

Source: Author's elaboration.

Figure 8 shows that in the third round, the number of participants splitting the funds equally is greater than in the first round. Nevertheless, according to the results of the paired two-tailed Wilcoxon rank sum test (see Table 5), the null hypothesis about the identical cumulative distribution of funds in the first and third rounds cannot be rejected.



Source: Author's elaboration.

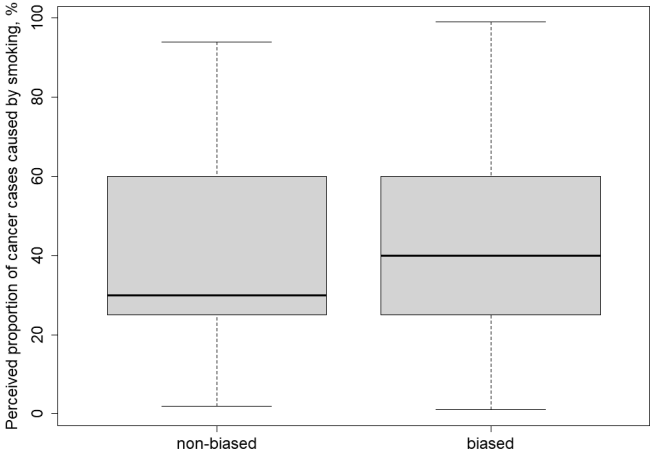
Figure 8 Distribution of the Proportion of Public Health Care Funds Assigned to the Former Smokers Group in the First and Third Rounds of the Experiment (n = 105)

Table 5 The Results of the Non-Parametric Paired Two-Tailed Wilcoxon Rank Sum Test for Public Health Care Funds Assigned to the Former Smokers Group in the First and Third Rounds of the Experiment (n = 105)

Null hypothesis	The proportion of funds assigned to the former smokers group in the first round is equal to the proportion of funds assigned to the former smokers group in the third round
Alternative hypothesis	The proportion of funds assigned to the former smokers group in the first round is not equal to the proportion of funds assigned to the former smokers group in the third round
p-value	$p = 0.7652$

Source: Author's elaboration.

It should be noted, nevertheless, that although there is no statistically significant difference between the public funds distribution in the first and the third rounds, there is some indirect evidence in favour of the Bayesian updating hypothesis. In particular, in contrast to the first-round results (see Table 3), there is no statistically significant difference in the perceived probability of cancer caused by smoking among the groups of respondents discriminating and not discriminating against the smokers in the third round (see Figure 9 and Table 6).



Source: Author's elaboration.

Figure 9 The Perceived Probability of Cancer Caused by Smoking among the Groups of Respondents Who Did Not Discriminate (Non-Biased, n = 49) and Discriminated (Biased, n = 56) against the Smokers during the Third Round of the Experiment

Table 6 The Results of the Non-Parametric One-Tailed Wilcoxon Rank Sum Test for the Difference between the Perceived Probability of Cancer Caused by Smoking among the Groups of Respondents Who Discriminate and Do Not Discriminate against Former Smokers in the Third Round of the Experiment (n = 105)

Null hypothesis	The perceived probability of cancer caused by smoking is identical among the respondents discriminating and not discriminating against the smokers in the third round.
Alternative hypothesis	The respondents discriminating against the former smokers in the third round report on a higher perceived probability of cancer caused by smoking in comparison to respondents who did not discriminate against the smokers in the third round.
p-value	$p = 0.1015$

Source: Author's elaboration.

4. Conclusion

The human mind naturally tends to establish causal links. Nevertheless, the process of causality detection is subject to numerous cognitive biases. The present study explored the effect of causality perception biases on the desired social funds distribution pattern utilizing a thought experiment methodology.

During the experiment, the participants were asked to split public health care funds between former smokers groups and patients who never smoked (the groups were of equal size). No additional information was provided. The rational decision would be to split the funds equally; however, a large proportion of funds was assigned to the group of patients who never smoked. The result proves that although tending to establish causal links, individuals commonly ignore imperfect information constraint. In addition, the result is in line with the hypothesis that perception of causality affects social distribution choice through the channels of responsibility and justice. The traditional approach states that individuals derive the degree of moral responsibility based on the objectively estimated causal links (Shaver 1985; Weiner 1995; Sloman, Fernbach, and Ewing 2009). The alternative approach (Knobe 2005; Knobe and Fraser 2008; Hitchcock and Knobe 2009; Alicke, Rose, and Bloom 2014; Kominsky et al. 2015) suggests that evaluating the degree of responsibility is subjective and precedes establishing causal links between the act and outcome. In other words, instead of being a basis for reasonable conclusions, in the human mind, causality serves as justification for subjective beliefs about consistency of the act with moral and social norms. The present paper presents evidence against the traditional approach, proving that individuals are likely to discriminate against people who demonstrate socially undesirable behaviour (in our case, smoking).

In addition, subjectively estimated causal weight of smoking was proven higher in the group of respondents who discriminated against smokers in the first round of experiment. Finally, the study provided mixed evidence regarding the ability of agents to update their prior beliefs in the light of new information. On the one hand, there was no statistically significant difference between the patterns of preferred public health care funds distribution in the first and the third round, when participants had a chance to change their choice of funds distribution after familiarizing themselves with information about possible cancer causes, other than smoking. On the other hand, there was no statistically significant difference between the perceived probability of cancer caused by smoking among the groups of respondents discriminating and not discriminating against the former smokers in the third round. Perhaps, detecting the patterns of Bayesian updating in human cognition would require further investigations.

The conceptual scheme of transforming the perception of causal links into the social distribution choice suggests that the latter variable is determined by a variety of other factors, such as perception of control, social distribution preferences, etc. The functional links between these variables are subject to further analysis.

References

Alicke, Mark D. 1992. "Culpable Causation." *Journal of Personality and Social Psychology*, 63(3): 368-378. http://dx.doi.org/10.1037/0022-3514.63.3.368

Alicke, Mark D., David Rose, and Dori Bloom. 2014. "Causation, Norm Violation, and Culpable Control." In *Experimental Philosophy*, ed. Joshua Knobe and Shaun Nichols. Oxford: Oxford University Press. http://dx.doi.org/10.1093/acprof:osobl/9780199927418.001.0001

American Cancer Society. 2018. "Cancer Facts & Figures." https://www.cancer.org/content/dam/cancer-org/research/cancer-facts-and-statistics/annual-cancer-facts-and-figures/2018/cancer-facts-and-figures-2018.pdf.

Andreoni, James, and John Miller. 2002. "Giving according to GARP: An Experimental Test of the Consistency of Preferences for Altruism." *Econometrica*, 70(2): 737-753. http://dx.doi.org/10.1111/1468-0262.00302

Bénabou, Roland, and Efe A. Ok. 2001. "Social Mobility and the Demand for Redistribution: The POUM Hypothesis." *Quarterly Journal of Economics*, 116(2): 447-487. http://dx.doi.org/10.1162/00335530151144078

Bernstein, Sara. 2017. "Causal Proportions and Moral Responsibility." In *Oxford Studies in Agency and Responsibility*, Vol. 4, ed. David Shoemaker, 165-182. Oxford: Oxford University Press. http://dx.doi.org/10.1093/oso/9780198805601.001.0001

Bowles, Samuel, and Herbert Gintis. 2000. "Reciprocity, Self-Interest, and the Welfare State." *Nordic Journal of Political Economy*, 26: 33-53.

Buchanan, Allen, and Debora Mathieu. 1986. "Philosophy and Justice." In *Justice: Views from Social Sciences*, ed. Ronald L. Cohen, 11-45. New York: Plenum Press. http://dx.doi.org/10.1007/978-1-4899-3511-3_2

Buehner, Mark J., Patricia W. Cheng, and Debora Clifford. 2003. "From Covariation to Causation: A Test of the Assumption of Causal Power." *Journal of Experimental Psychology: Learning Memory and Cognition*, 29(6): 1119-1140. http://dx.doi.org/10.1037/0278-7393.29.6.1119

Centers for Disease Control and Prevention. 1982. "A Cluster of Kaposi's Sarcoma and Pneumocystis carinii Pneumonia among Homosexual Male Residents of Los Angeles and Orange Counties, California." *Morbidity and Mortality Weekly Report*, 31(23): 305-307.

Chater, Nick, Mike Oaksford, Ulrike Hahn, and Evan Heit. 2010. "Bayesian Models of Cognition." *Wiley Interdisciplinary Reviews: Cognitive Science*, 1(6): 811-823. http://dx.doi.org/10.1002/wcs.79

Cheng, Patricia W., and Mark Buehner. 2005. "Causal Learning." In *The Cambridge Handbook of Thinking and Reasoning*, ed. Keith J. Holyoak and Robert G. Morrison, 143-168. Cambridge, M. A.: Cambridge University Press. http://dx.doi.org/10.1093/oxfordhb/9780199734689.013.0012

Coenen, Anna, Bob Rehder, and Todd M. Gorecki. 2015. "Strategies to Intervene on Causal Systems Are Adaptively Selected." *Cognitive Psychology*, 79: 102-133. http://dx.doi.org/10.1016/j.cogpsych.2015.02.004

Cohen, Ronald L. 1986. "Introduction." In *Justice: Views from Social Sciences*, ed. Ronald L. Cohen, 11-45. New York: Plenum Press.

Dawes, Christopher, James Fowler, Tim Johnson, Richard McElreath, and Oleg Smirnov. 2007. "Egalitarian Motives in Humans." *Nature*, 446: 794-796. http://dx.doi.org/10.1038/nature05651

Emlet, Charles A., Karen I. Fredriksen-Goldsen, Hun-Jun Kim, and Charles Hoy-Ellis. 2017. "The Relationship between Sexual Minority Stigma and Sexual Health Risk Behaviors among HIV-Positive Older Gay and Bisexual Men." *Journal of Applied Gerontology*, 36(8): 931-952. http://dx.doi.org/10.1177/0733464815591210

Fincham, Frank D., and Joseph M. Jaspars. 1980. "Attribution of Responsibility: From Man the Scientist to Man as Lawyer." *Advances in Experimental Social Psychology*, 13: 81-138. http://dx.doi.org/10.1016/S0065-2601(08)60131-8

Frosch, Caren A., and P. N. Johnson-Laird. 2011. "Is Everyday Causation Deterministic or Probabilistic?" *Acta Psychologica*, 137(3): 280-291. http://dx.doi.org/10.1016/j.actpsy.2011.01.015

Gendler, Tamar S. 2007. "Philosophical Thought Experiments, Intuitions, and Cognitive Equilibrium." *Midwest Studies in Philosophy*, 31(1): 68-89. http://dx.doi.org/10.1111/j.1475-4975.2007.00154.x

Goodman, Noah D., Tomer D. Ullman, and Joshua B. Tenenbaum. 2011. "Learning a Theory of Causality." *Psychological Review*, 118(1): 110-119. http://dx.doi.org/10.1037/a0021336

Gredeback, Gustaf, Anders Winman, and Peter Juslin. 2000. "Rational Assessments of Covariation and Causality." In *Proceedings of the Twenty-Second Annual Conference on the Cognitive Science Society*, 22: 190-195.

Griffiths, Thomas L., Nick Chater, Dennis Norris, and Alexandre Pouget. 2012. "How the Bayesians Got Their Beliefs (and what Those Beliefs Actually Are): Comment on Bowers and Davis (2012)." *Psychological Bulletin*, 138(3): 415-422. http://dx.doi.org/10.1037/a0026884

Hamilton, Lee V., and Joseph Sanders. 1992. *Everyday Justice: Responsibility and the Individual in Japan and the United States*. New Haven, C. T.: Yale University Press.

Harsanyi, John C. 1953. "Cardinal Utility in Welfare Economics and in the Theory of Risk-Taking." *Journal of Political Economy*, 61(5): 434-435. http://dx.doi.org/10.1016/0047-2352(94)90085-X

Hitchcock, Christopher. 2001. "Causality: Models, Reasoning, and Inference." *Philosophical Review*, 110(4): 639-641. http://dx.doi.org/10.1215/00318108-110-4-639

Hitchcock, Christopher, and Joshua Knobe. 2009. "Cause and Norm." *Journal of Philosophy*, 106(11): 586-612. http://dx.doi.org/10.5840/jphil20091061128

Huerta, Elmer, and Nathan Grey. 2009. "Cancer Control Opportunities in Low- and Middle-Income Countries." *CA: A Cancer Journal for Clinicians*, 57(2): 72-74. http://dx.doi.org/10.3322/canjclin.57.2.72

Jones, Matt, and Bradley C. Love. 2011. "Bayesian Fundamentalism or Enlightenment? On the Explanatory Status and Theoretical Contributions of Bayesian Models of Cognition." *Behavioral and Brain Sciences*, 34(04): 169-188. http://dx.doi.org/10.1017/s0140525x10003134

Kao, Shu-Fang, and Edward A. Wasserman. 1993. "Assessment of an Information Integration Account of Contingency Judgment with Examination of Subjective Cell Importance and Method of Information Presentation." *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 19(6): 1363-1386. http://dx.doi.org/10.1037/0278-7393.19.6.1363

Knobe, Joshua. 2005. "Theory of Mind and Moral Cognition: Exploring the Connections." *Trends in Cognitive Sciences*, 9(8): 357-359. http://dx.doi.org/10.1016/j.tics.2005.06.011

Knobe, Joshua, and Ben Fraser. 2008. "Causal Judgements and Moral Judgements: Two Experiments." In *Moral Psychology*, ed. Walter Sinnott-Armstrong, 441-447. Cambridge, M. A.: MIT Press.

Kominsky, Jonathan F., Jonathan Phillips, Tobias Gerstenberg, David Lagnado, and Joshua Knobe. 2015. "Causal Superseding." *Cognition*, 137: 196-209. http://dx.doi.org/10.1016/j.cognition.2015.01.013

Langer, Ellen J. 1975. "The Illusion of Control." *Journal of Personality and Social Psychology*, 32(2): 311-328. http://dx.doi.org/10.1037/0022-3514.32.2.311

Luhmann, Christian C., and Woo-Kyoung Ahn. 2005. "The Meaning and Computation of Causal Power: Comment on Cheng (1997) and Novick and Cheng (2004)." *Psychological Review*, 112(3): 685-692. http://dx.doi.org/10.1037/0033-295X.112.3.685

Marcus, Gary F., and Ernest Davis. 2013. "How Robust Are Probabilistic Models of Higher-Level Cognition?" *Psychological Science*, 24(12): 2351-2360. http://dx.doi.org/10.1177/0956797613495418

Matute, Helena. 1995. "Human Reactions to Uncontrollable Outcomes: Further Evidence for Superstitions Rather Than Helplessness." *The Quarterly Journal of Experimental Psychology*, 48(2): 142-157. http://dx.doi.org/10.1080/14640749508401444

Matute, Helena. 1996. "Illusion of Control: Detecting Response-Outcome Independence in Analytic but Not in Detecting Response-Outcome Independence in Analytic but Not in Naturalistic Conditions." *Psychological Science*, 7(5): 289-293. http://dx.doi.org/10.1111/j.1467-9280.1996.tb00376.x

Matute, Helena, Fernando Blanco, Ion Yarritu, Marcos Diaz-Lago, Miguel A. Vadillo, and Itxaso Barberia. 2015. "Illusions of Causality: How They Bias Our Everyday Thinking and how They Could Be Reduced." *Frontiers in Psychology*, 6(888). http://dx.doi.org/10.3389/fpsyg.2015.00888

Mikula, Gerold. 2001. "Justice: Social Psychological Perspectives." In *International Encyclopedia of the Social and Behavioral Sciences*, ed. N. J. Smelser and Paul B. Baltes, 8063-8067. London: Pergamon Press. http://dx.doi.org/10.1016/B0-08-043076-7/01808-8

Miller, David T., and Michael Ross. 1975. "Self-Serving Biases in the Attribution of Causality: Fact or Fiction?" *Psychological Bulletin*, 82(2): 213-225. http://dx.doi.org/10.1037/h0076486

Montada, Leo. 1991. "Coping with Life Stress Injustice and the Question 'Who Is Responsible?'" In *Social Justice in Human Relations*, ed. Herman Steensma and Riël Vermunt, 9-30. New York: Plenum Press. http://dx.doi.org/10.1007/978-1-4899-2629-6_2

Pearl, Judea. 2000. *Causality: Models, Reasoning and Inference*. 2nd ed. Cambridge, M. A.: Cambridge University Press. http://dx.doi.org/10.1017/CBO9780511803161

Schlenker, Barry R., Thomas W. Britt, John Pennington, Rodolfo Murphy, and Kevin Doherty. 1994. "The Triangle Model of Responsibility." *Psychological Review*, 101: 632-652. http://dx.doi.org/10.1037/0033-295x.101.4.632

Schulz, Laura E., and Jessica Sommerville. 2006. "God Does Not Play Dice: Causal Determinism and Preschoolers' Causal Inferences." *Child Development*, 77(2): 427-442. http://dx.doi.org/10.1111/j.1467-8624.2006.00880.x

Shanks, David R., and Anthony Dickinson. 1988. "Associative Accounts of Causality Judgment." *Psychology of Learning and Motivation - Advances in Research and Theory*, 21(C): 229-261. http://dx.doi.org/10.1016/S0079-7421(08)60030-4

Shaver, Kelly G. 1985. *The Attribution of Blame: Causality, Responsibility, and Blameworthiness*. New York: Springer-Verlag.

Sloman, Steven A., Philip M. Fernbach, and Scott Ewing. 2009. "Causal Models: The Representative Infrastructure for Responsibility Judgment." *Moral Judgment and Decision Making*, 50: 1-26. http://dx.doi.org/10.1016/S0079-7421(08)00401-5

Sorensen, Roy A. 1992. "Thought Experiments and the Epistemology of Laws." *Canadian Journal of Philosophy*, 22(1): 15-44. http://dx.doi.org/10.1080/00455091.1992.10717269

Stevenson, Charles L. 1938. "Ethical Judgments and Avoidability." *Mind*, 47: 45-57.

Tauber, Sean, Daniel J. Navarro, Amy Perfors, and Mark Steyvers. 2017. "Bayesian Models of Cognition Revisited: Optimality Aside and Letting Data Drive Psychological Theory." *Psychological Review*, 124(4): 410-441. http://dx.doi.org/10.1037/rev0000052

Tenenbaum, Joshua B., Charles Kemp, Thomas L. Griffiths, and Noah D. Goodman. 2011. "How to Grow a Mind: Statistics, Structure, and Abstraction." *Science*, 331(6022): 1279-1285. http://dx.doi.org/10.1126/science.1192788

Waldmann, Michael R., York Hagmayer, and Aaron P. Blaisdell. 2006. "Beyond the Information Given." *Current Directions in Psychological Science*, 15(6): 307-311. http://dx.doi.org/10.1111/j.1467-8721.2006.00458.x

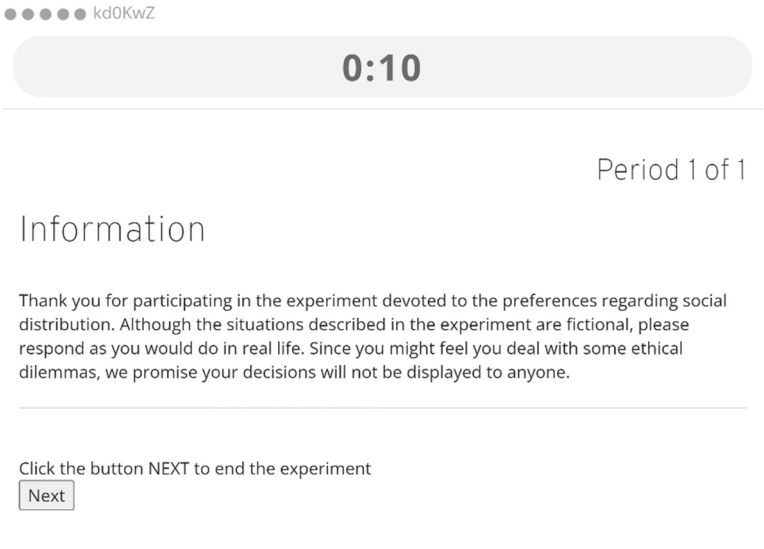
Weiner, Bernard. 1995. *Judgments of Responsibility: A Foundation for a Theory of Social Conduct*. New York: Guilford Press.

White, Peter A. 1990. "Ideas about Causation in Philosophy and Psychology." *Psychological Bulletin*, 108(1): 3-18. http://dx.doi.org/10.1037/0033-2909.108.1.3

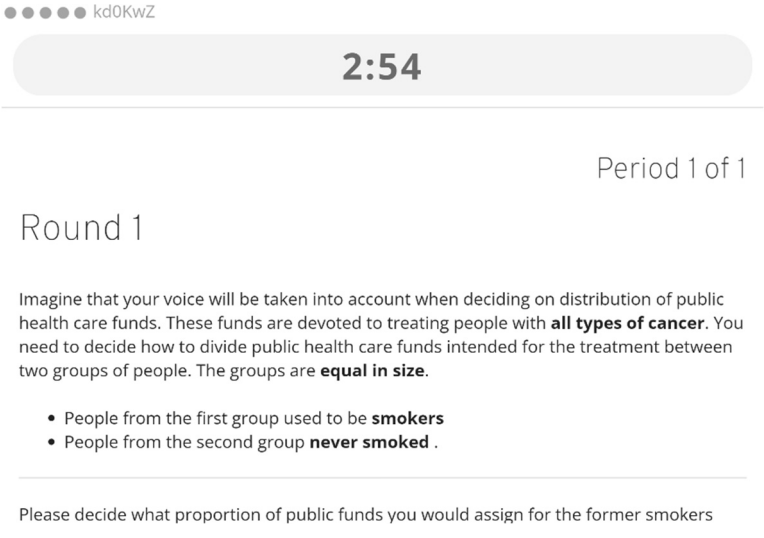
Appendix

Scans of the Experiment

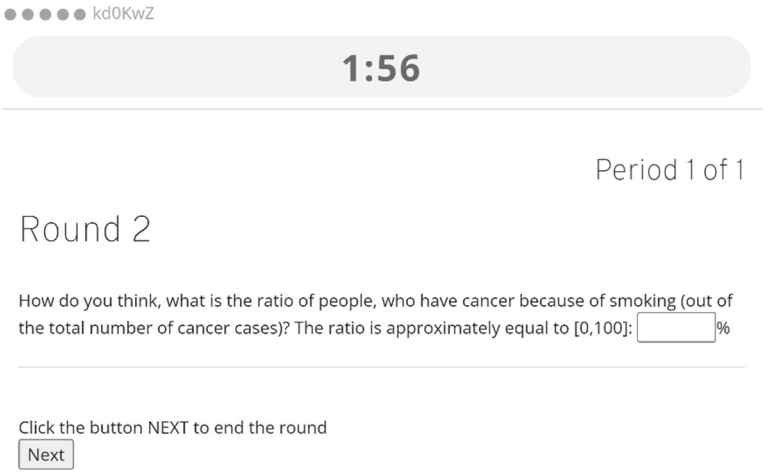
First scan of the experiment



Second scan (first round) of the experiment



Third scan (second round) of the experiment



Fourth scan (third round) of the experiment