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Nudging the public:

**Relevance, antecedents and the level of public support
for behaviorally informed policies**

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Doctoral dissertation

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Budapest, 2022

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1. Dissertation summary

1.1. Research background and relevance of the chosen field

The rise of behavioral economics to the mainstream of economic research has greatly extended our understanding of human judgment and decision-making. Daniel Kahneman and Amos Tversky shed light on how cognitive, psychological, cultural and social factors affect the decisions of individuals and how these vary from those implied by classical economic theory. Their findings were summarized in an excellent book by Kahneman titled "Thinking fast and slow". Reading that book, along with the book of Ariely and Jones "Predictably irrational", was the reason I became interested in pursuing academic research. Behavioral economics helped as understand the mechanisms of the non-rational influence on our decision making because of pioneer researchers like Daniel Kahneman, who was awarded the Nobel Prize for Economics in 2002 for his accomplishments. The modes of influence on the exact decision environment was further conceptualized by Richard Thaler and Cass Sunstein in their book "Nudge" (2008), where they coined the term 'choice architecture'. They discussed the different manipulating effects that have a larger than intuitively imagined effect on our decision making, and showed surprising evidence for the not exactly new (Lerner and Lasswell 1951) field of policy science.

The concept discussed in the book of Thaler and Sunstein has become a huge academic success in the past decade. According to Google Scholar, as of early 2022, the book was cited more than ten thousand times and this number is still increasing, especially in view of the fact that one of the authors, Richard Thaler was, in 2017, also awarded the Nobel Prize for Economics for his relevant contributions to the field. As the justification for the prize claims, Thaler's work in the development of behavioral economics has helped it gain a better understanding of human behavior and formulate better predictions about it, which has a cumulative, significant effect on economics, and, by the same token, it has helped to steer this slightly controversial, peripheric

area towards the mainstream. As result, the conscious application of nudges in public policymaking (also referred to as behaviorally informed policies) has grown exponentially, so much so that some countries have even establish 'Nudge Units' to research opportunities and prepare proposals to apply nudges in policy (Whitehead et al. 2014).

My personal motivation has driven me to research nudges applied in a public policy, that steer people in the direction of better decisions. As the section concerning "the criticism of the use of nudges" in the systematic literature review article explains, this kind of influencing and the issue of formulating "the better decision" have given rise to heated debate among those dealing with nudges, ethics, and public policy making. My personal view is that the positive results available through the use of nudges should not be neglected, and their use should be extended to a conscious level, just like in the case of the United Kingdom, where a specialized "nudge unit," the Behavioural Insights Team has been established, dedicated to the support of the government's decision making. I would endorse this practice as long as it is based on well-established research, it presents its findings in a transparent manner, and it is openly communicated to society (in general, not necessarily in the given decision-making environment in which a nudge is applied). In this way, a social discourse can develop as to what is an acceptable extent of influencing and what is not, and the use of nudges, which do not conform to the values of the population, can be rejected.

During the course of my doctoral studies the pandemic situation caused by COVID-19 has become a critical aspect in all of our lives, therefore I wanted to reflect it in my research. The real life implication of support for the preventive policies directly translated to the effectiveness of pandemic defense, and therefore meant lives. Obviously the topic captivated my scientific curiosity and I wanted to tackle it with novel scientific research to provide timely insights to an eager worldwide audience. One topic that emerged relating to nudges was comparisons in level of public support for and compliance with very strict or advisory measures aiming to contain the pandemic. When the pandemic broke out, the main objective of responsible researchers in social science was to understand what factors contribute to people complying with the

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preventive measures and for this reason we investigated these factors by measuring support for these policies. The natural environment also provided the opportunity to observe a very specific context, one in which the perception of risk is very high and most members of society feel very involved in the surveyed topic. For these studies I had to also dig deep into the rich field of risk research, and for this reason my last study is concerned mainly with the relationship of risk perception and Covid skepticism, which are key in the belief and opinion formation processes about preventive policies.

1.2. Research frame

I write my dissertation based on published articles around the topic of nudges in public policy. The relation of research questions, publications and results of the studies I conducted are shown on Figure 1. The foundation of my dissertation was a systematic literature review on nudges applied in public policy. This review and categorization exercise did not only provide a good summary for interested readers on the mechanisms, application and criticisms of nudge, but also helped me to find emerging research questions of the literature, that are worth to explore. The literature review surfaced that there are many different modes of action and many different domains that nudges can be applied on. At the time when I started my dissertation there were two influential studies on the topic of public support for behaviorally informed policies, Jung and Mellers (2016) and Reisch and Sunstein (2016) researched attitudes toward nudging with large American and European samples respectively. They also used various types of nudges applied to various fields, showed differences but tried to draw overarching conclusions. I was interested in exploring the underlying effects, how the domain, the mechanism or the current context might affect the support for the policies. For this reason, I included nudges from 7 different domains to be able to observe the domain effect in Study II, and also in Studies III and IV policies under extreme circumstances due to the pandemic provided a special context to research.

Study I.
Systematic Literature Review for keywords:
"Nudge" & "Policy"
Vezetéstudomány [B] /awarded article/

> Catalogue of nudge mechanisms
> Summary of criticisms
> Review of policy applications

RQs emerging around how various factors influence level of support for behaviorally informed policies

transparency - knowing the goal of the actor

alternatives - showing different means

context - dependence on the applied domain

individual traits - psychometrics

Study II.
Support of nudges in wider policy context [revealing purpose and other policies]
SPUDM poster - Working paper

> Showing alternatives has no influence
> Showing the goal decreases support
> Support is greatly domain specific

Study III.
Nudges vs regulations during Covid [risk perception <> policy support]
PLOS ONE [Q1]

> Those with higher risk perception prefer the regulation approach more
> Who had been sick had higher risk perception but supported policies less

Study IV.
Determinants of Covid policy support [skepticism <> policy support]
Statisztikai Szemle [A]

> Skepticism is strong predictor
> Skep. depends a lot on worldviews
> Faith in scientists helps in support

RQs emerging on Covid risk

connection between skepticism and risk perception

Study V.
Risk perception during Covid, longitudinally [skepticism <> risk perception]
Journal of Risk Research [D1]

> The context changes some predictors of risk perception from 2nd to 4th wave
> Strong predictors remain significant: Skepticism, prosociality, trust in science

Figure 1.: Relation of research questions, publications and results

Another phenomenon emerging in the literature was that nudges often compete with the more traditional policy toolbox (regulations, financial incentives). Hagmann et al. (2019) even found that the introduction of nudges can crowd out support for stricter measures. I found it an interesting question to measure support for different type of policies that have the same goal, and this was central part of Study II, in which I compared support of five different types of policies with the same goal (regulations, positive financial incentives, negative financial incentives, subliminal nudges and transparent nudges), and also in Study III, in which I compared regulations and nudges employed as preventative Covid containment policies. This comparative surveying I found also apt to lead to a more ethical practice. The literature review also revealed the criticisms of nudge. Nudging can be manipulative as it is not transparent

for the citizens that their behavior is intentionally influenced, and the political actor can be seen paternalistic, trying to influence the citizens 'for their own good'. These issues could be remedied by revealing the purpose of the actor and the available means to get to their goal. In Study II, we explored the effect of these different frames: showing only the policy; showing its purpose as well; and showing both the purpose and the various alternatives. Thus we hoped our findings can lead to the application of nudges more ethically.

The influence from cultural background and psychological traits of the respondent is again a deep field for nudge effect and nudge acceptance research. The literature showed numerous articles that found different attitudes toward or different effects from nudges. Some elements of this I also tried to incorporate in my research, as was fitting to each of the studies. In Study II, where the purpose of the policymaker was revealed, we expected reactant individuals to behave differently than others when the topic of influencing and the feeling of manipulation might arise, so we included a psychological reactance questionnaire in our survey to measure its association with policy support under different frames. In Studies III and V we measured the Covid related risk perception, while in Studies IV and V we measured individuals world-views, trust in various institutions or people, as well as their Covid skeptic stance. In the context of the pandemic these attitudes were important for support and compliance with the preventive policies. Study V was building more on findings of my previous Covid related studies and not on the initial literature review. In that case I found the connection between skepticism and risk perception a topic worth to further explore based on the findings of the earlier research and on a review of the existing wealth of risk research.

1.3.   Overview of the studies

In this section, I summarize my compiled studies on the topic of support for public policies, specifically nudges. First, the systematic literature review that I performed

to identify and understand the emergent topics in the field, then the four original studies involving empirical data collection. These studies, mixing survey methodology with experimental elements, investigate how factors like the role of transparency, the domain of application, the subjects' psychological traits (such as reactance, individualism, prosociality, trust), or their attitudes (risk perception and skepticism) influence the support for behaviorally informed policies. One of the policy contexts - containment of the pandemic - became so important that it was even explored with a connecting study that looked beyond policy support. The findings presented in the dissertation provide useful implications for theoretical researchers and practitioners of public policy making.

Study I. The inner workings of choice architecture. The theory, mechanisms and criticism of nudging

The study presented here is a comprehensive summary that served as a theoretical basis and inspiration for all my later research. The purpose of the study was a systematic assessment of nudges applied in public policy, and to reveal critical aspects that shape the public discourse about them. The paper explores the literature on nudges and classifies the different ways of realizing it. This systematic literature review article is based on a selection of 129 articles, which were obtained as results of a query of the EBSCO database. We searched for peer-reviewed academic journal articles published between 2008 and September 2016 that contained the keywords "nudge" and "policy" in their abstracts. After reviewing the abstracts, we filtered out 20 papers which were either irrelevant to our research, or interpreted the concept of nudges too widely, or they merely mentioned it in passing. Furthermore, 30 other papers were also excluded from the review, since they covered such wide-ranging topics that they did not fit this comprehensive synthesis. The primary focus of our synthesis was those applications and phenomena which might make nudges effective, and we also focused on academic papers discussing the policy application of nudges or on the concerns regarding the use of nudges.

The paper explores the literature on nudges and classifies the different ways of realizing it. This nudge catalog identifies twelve modes of actions how nudges operate (defaults, different forms of disclosure, framing, incentives, emotional associations, social norms, priming, personal commitment, prompting an active choice, attention and cognitive accessibility, positioning options, taking advantage of temporal inconsistencies in decision-making). The catalog of nudges' modes of action connects the behavioral theory to the applied form of choice architecture in the context of political science, and building on that, with a wide range of examples highlighted from existing research, it introduces exact instances of their policy applications. The concept of nudge became the center of political, philosophical and ethical debates soon after it emerged to the forefronts of behavioral economic discourse (induced by Thaler and Sunstein 2008). The majority of papers featured in the literature review articulate criticisms about the concept, which led us to believe that it is probably imperative for the future success of the concept that the proponents of nudges give reassuring answers to the critics' concerns.

We categorized the criticism into four main groups. (1) The so-called a grand narrative critique that emphasizes that nudges often provide symptomatic treatments but do not really provide comprehensive solutions to various major social problems. (2) Another significant criticism is that, the makers of public policies do not necessarily always know what is good for the citizens, this is the so-called critique of paternalism (Hansen and Jespersen 2013). Even though proponents of nudge usually assume that public policymakers always have good intentions and have all the information to make effective interventions in people's decision-making environment, that might not always be the case. (3) Nudges are often attacked on the ethical grounds that nudges are in most cases non-transparent and manipulative. Many nudges work well precisely because people are not aware that others want to influence them. Several people argue that trust in social institutions can also be damaged if it turns out that the makers of public policies are manipulating people, even if they want to protect them from themselves. (4) In addition to all of this, several practical problems may arise when

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using nudges, as they may result in side effects that their creators did not foresee, and are often not compatible with other government actions. Moreover, some authors draw attention to the fact that certain nudge programs can be very expensive (Amir and Lobel 2008), and thus can divert financial resources from programs that could potentially show positive results with even greater efficiency.

The paper also reviews on what domains are these nudges in public policy applied. Nearly two-thirds of those papers which examine the use of nudges in a specific area are concerned with healthcare. The overwhelming majority of these papers deal with healthcare issues in general or comprehensively, but some of the specific areas they touch upon are diets, nutrition and obesity. There were a smaller but still meaningful number of papers about nudges concerning environmental issues, as well as pension scheme incentives. Every other topic came up only once or twice in the course of the literature review, so we can safely say that healthcare, environment protection and pension schemes are the three areas which are the most attractive to the use of nudges. Based on the literature review, it is noticeable that many of the papers were concerned with examples from the United Kingdom, since this is the country which first raised the use of nudges to the level of governance. This is, of course, not surprising, but it raises the issue of cultural effects and also to what extent can we generalize the studies that have been conducted so far: although recently there have been attempts at comparative analyses, the number of these is negligible.

Methodological approach for the empirical studies

All four empirical studies utilized survey research, because in all of them we looked for answers regarding public opinion and attitude questions. The surveys were developed rigorously and sampling was considered carefully to avoid errors associated with the respondents or their answers (Fowler Jr 2013). One requirement of professional research is that it should have internal validity, meaning to ensure that we measure what we intended to measure. For this reason, the question items underwent appropriate

scale development for each survey. We also did pretesting with a score of respondents and briefly interviewed them to further polish the questionnaires and make sure they are understood the same way and exactly as we intended. All participants provided informed consent to use their responses in our research. The exact statistical methodology with which we analysed the results was customized to each study accordingly, because we aimed to have a rigorous analysis in each case.

The main method of public opinion and attitude research is of course the survey research, but researchers of public opinion frequently embed experimental elements in opinion surveys which I also embraced with all of its advantages and challenges (Gaines et al. 2007). Some of the surveys I employed also had experimental elements as a split ballot survey, and looked for the effect of differently framed questions (Study II) or the effect of question order and priming (Study IV). I was very keen to include experimental elements to increase the value of my findings. As Koltai et al. (2015) puts it, the controlled experiments are a great method for social science research because it is 'good enough' in all three dimensions, instead of a method which performs perfectly in one dimension but fails in the other sections. Together with a sound survey development and appropriate sampling, it should aid my research to have a good internal and external validity, and reliability (replicability) which are the main components social science research validity (Drost 2011, p. 106). The representative sample of Study III, the experimental elements in Studies II and IV, and the longitudinal nature of Study V also enhances external validity, so that the results of my studies can be generalized and used to predict behaviours in real life.

Study II. Support of nudges in wider policy context. A survey experiment

The most common critique of nudges is that their manipulative nature and undercover influence on decision makers is not ethically sound. Moreover, even if their application in the choice architecture results the desired effect, it does not foster the internalization of norms, it doesn't bring along a mindset change among citizens. We

hoped to demonstrate that two techniques, which can make the application of nudges more ethical and conscious, will also lead to a greater public support for them. So, we tested different frames to the questions around policy support by also including a description of the purpose, as well as encouraging broader views on a specific topic by introducing policy alternatives. We assessed people's opinion across seven different topics, where behaviorally informed policies are common (smoking, retirement saving, energy consumption, organ donation, speeding, screening examination, sugar consumption). Psychological reactance of the respondents was assessed with a range of 14 items adapting the scale developed by Hong and Faedda (1996).

In the study participants were allocated to the three conditions randomly. In condition 1 participants rated system 1 nudges in seven different domains. In condition 2 the purpose of the same system 1 nudges were revealed to the participants. In condition 3 besides the purpose, four other competing policy alternatives (enforced regulation, negative incentive, positive incentive, and system 2 nudge) were presented to the subjects, and they were expected to rate all policy options. In the online questionnaire for attitude questions a 7-point-scale was used, in order to find out to what extent participants support policy alternatives and to what extent they think alternatives are effective. For the study we recruited 319 students studying business administration at a major Hungarian university for this study. Subjects completed an online survey in November 2018 using 'Qualtrics' software. During the statistical analysis an ANOVA test was conducted to compare the support level in the three samples relating to the three experimental conditions. While correlational coefficients were analyzed to understand associations between reactance trait and policy support.

We focused on system 1 nudges since they usually operate in the dark, therefore they tend to be also less accepted. Our findings suggest that this generally lower levels of support cannot be explained with people not being fully aware of the purpose of the policy makers, since raising awareness of that purpose even reduced the support for the nudges in our sample. These results are somewhat disheartening and do not help to step toward a more ethical practice and transparency around nudges. It also

Study II. Support for subliminal nudges under different frames
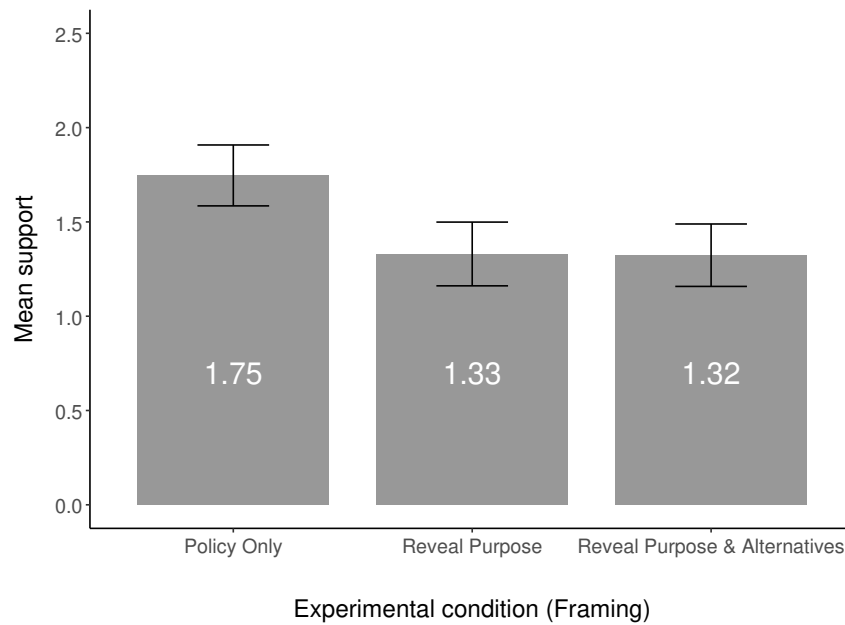
Figure 2.: The figure reports the mean support, across domains, for policies involving system 1 nudges under the experimental conditions. The range of options for support were coded between [-5 and 5]. Error bars represent 95 percent confidence intervals.

cautions policymakers on the application of nudge and calls for further research about properly applying and communicating behaviorally informed policies. People also keep their reservations about subliminal nudges when they learn what these policy interventions may be substituted with. Offering a variety of policy alternatives that work toward the same purpose did not effect the support for system 1 nudges in our study. While Hagmann et al. (2019) claim that introducing a nudge alongside a taxing alternative decrease support for the taxes, we could say that the reverse, introducing taxation alongside a nudge did not increase the support for the nudge. Importantly, we did not only include taxation but other alternatives as well, which could have affected the results.

Our findings suggest, that public support for nudges is greatly influenced by the domain where the nudge is introduced. For example, opt-out organ donation schemes were supported by only half of the participants while road markings that encourage slow driving was supported by more than 90% of our respondents. Notably, support

for nudges in the same domain may even vary a lot, see for example the results of Reisch et al. (2017). It may question an assumption made by most studies dealing with public support of nudges, namely that support for domain-specific nudges can be simply aggregated. The reactance trait was not as strongly associated with nudge support as we hypothesized based on earlier studies. When we checked for the strength of correlation between the overall reactance index and the level of subliminal nudge support, we have found no statistically significant association in either condition, so we can not affirm a difference in attitude for people with reactant traits.

The reason to include a wider variety of options was to assess the effect of painting a full picture. The more ethical avenue of nudge applications in public policy would require full spectrum of tools to involve in all discussions, and find the best fit for each domain. The importance of finding the proper match is further backed by the relatively large variance in support for specific policy types (except in the case of overt nudges) across the investigated domains. It seems the acceptability of a policy type is always dependent on the applied field. It also means that playing with a contrast effect, by proposing stricter policies just to gather support for others, would generally not work. Future research should identify domains where nudges are more accepted and/or supported, and domains where other policies may work better such as negative or positive incentives or enforced regulations.

Study III. Nudging in the time of coronavirus?

The importance of researching public support for preventive policies have been amplified by the COVID-19 pandemic. The highly elevated risk brought new implications for nudge research, and particularly, more emphasis on the debate of competing softer and harder policy strategies. It was established in literature previously, that people support nudges more than strict regulations on the same domain. We set out to test the truth of this in an extremely tense situation like the coronavirus pandemic and understand how it relates to individuals risk perception, by a survey. The sample used in

this research was the largest I had the pleasure to work with and it was also representative of the adult Hungarian population under the age of 64 in terms of demographics (age, gender, education). One thousand Hungarian participants were recruited for this study. An online survey design was applied, and the questionnaire was administered as part of a CAWI (Computer Assisted Web Interviewing) omnibus survey.

We measured COVID-19 risk perception with a range of items (also summarized in an aggregate index) that covers affective, cognitive, and temporal-spatial dimensions of risk perception based on Dryhurst et al. (2020). The construct contains six items: (1) level of worry, (2) perceived likelihood of direct personal effects, (3) perceived likelihood of direct effects on family members and friends, (4) personal beliefs about how many people in the country will be affected, (5) perceived probability of getting sick, and (6) getting sick seriously. We asked for opinions on three hard and three soft policy measures that participants had to rate, to what extent they supported them. For all of the above items a 7-point Likert scale was used. The policies we call softer, can be categorized as system 1 nudges, while the harder policies, are strict mandates also called regulations. The respondents' experience with COVID-19 was also assessed in the survey. When asking direct experience respondents had to answer whether they had COVID-19 or not. Surveying indirect experience we inquired if anyone in their direct environment (family members, close friends) have been infected with the coronavirus.

We evaluated policy support in a dichotomized form with contingency table based χ^2 tests as well as on the original distribution of responses given on the seven point scale, and tested the difference in support using non-parametric Wilcoxon - Mann - Whitney tests. We investigated the association between risk perception and soft and hard policy support with Pearson correlation coefficients and calculated coefficients for the three areas separately as well, because validity indicies suggested they should not be aggregated. To evaluate the effect the experience had on risk perception and policy support we took the Cartesian product of the two binary, experience variables and evaluate the mean risk perception, support for regulations and support for nudges

Study III. Policy support ratio in percentage for preventive measures
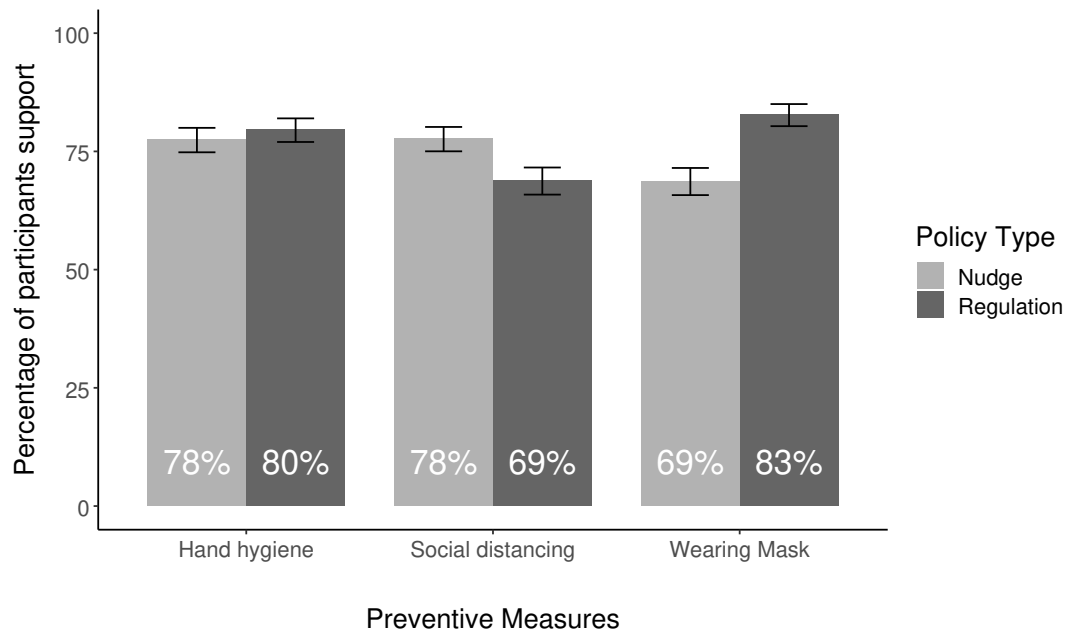
Figure 3.: The figure reports the percentage of respondents whose support was on the positive side of the scale (from 'rather support' to 'certainly support'), the midpoint (neutral) not included. Error bars represent 95 percent confidence intervals.

across the four groups using the constructed indicies. We used the Kruskal–Wallis test for one-way analysis of variance to determine differences in distribution among the groups, and complemented it with pairwise analysis using Mann–Whitney tests with Bonferroni correction to correct for multiple comparisons when calculating significance. This provided us with an understanding of the association between the experience with the disease and the other main variables separately, but to be able to focus more intently on the interaction of experience and risk perception, and how they can correspond to support for the policies, we also fit a regression model. Nudge support index and the regulation support index are defined as dependent variables in the OLS regression models, and risk perception index, the experience variables (examining models including just one or both together), and the interaction terms between risk and experience are included as independent variables.

In our representative sample the preventive policy measures were generally supported, and there were no clear pattern to whether hard or soft policy measures were

preferred. There was a moderate correlation between the risk perception index and the approval of both regulatory and nudge interventions. This level of correlation was similar across all prevention areas. Moreover, we found that people with a higher level of risk perception favor regulatory approaches slightly even more. Based on the results of our study we advise against the sole use of nudges in a pandemic that has brought unprecedented risks to most societies, since they suggest that the presence of high risk increases the public's preference for stricter regulations. If governments underplay the seriousness of the pandemic, which would therefore make people perceive the level of risk lower, that would undermine the public acceptance of any preventive measure. For this reason, politicians are in a delicate situation: they want to demonstrate their competencies and the effectiveness of the measures they implement, and they do not want to spark unnecessary panic.

Somewhat surprisingly, there seem to be two contradicting effects on policy support for people who already contracted the disease. While the experience's contribution to a higher risk perception should increase the level of support, there is also a tendency to support the preventive measures less. The direct experience negatively influences policy support, so in the early stages of a pandemic policy makers should pay special attention to those who had already contracted COVID-19. They may diminish the public support of the preventive measures because of their selfish desire to get back more freedom, stemming from a feeling of immunity, or by spreading a message that the disease does not cause big trauma. Therefore, in their risk communication, authorities ought to emphasize the protection of family members, friends, and vulnerable members of society by complying with preventive measures, instead of underlining the inherent dangers of catching a virus.

Study IV. What influences the support for anti-epidemic measures

Public reactions to the COVID pandemic ranged from extreme fear to the negligence of risk messages; one possible explanation for this is the skepticism about risk

factors or preventive strategies. The relationship between support for prevention policies and epidemic-related skepticism as well as other potential explanatory variables was examined in this research.

The questionnaire items for studies III, IV and V are partially overlapping. We used the same risk perception, policy support and experience variables as described in the section detailing methods for Study III. Although, from the policy support items we only used a subset, as we were not focused on differences between different types of policies. Instead of showing a regulation - nudge pair for each domain, out of the two we used only the policy that was actually in place at the time. These have been complemented by a range of items attempted to measure Covid skepticism, the worldview of the respondents (their individualism, their solidarity with society) and their trust in the competence of certain groups (e. g. whether scientists understand the pandemic properly or whether the government is able to handle it; whether others comply with preventative measures etc.). The questions measuring skepticism about COVID-19 were answered on a 7-point Likert scale. The questions were phrased as follows: "To what extent do you agree with the... (statement)" The statements were specifically selected for the present study and our aim was to grasp those COVID-skeptical arguments that were the most frequently used at the time of the data collection. We presented such viewpoints as 1. fatality statistics grossly overestimate the danger of the virus; 2. face masks are not effective; and 3. the economic damage caused by the restrictions is more severe than the health benefits thereof.

While we mainly focused on the relationships between risk perception and policy support in Study III, Study IV explores the relationship between skepticism and policy support, and how factors that determine policy support are connected. There was also an experimental element to the research, to handle the 'context effect' that can arise from the order of questions (Brecsok and Németh 2020). We randomly arranged the question blocks, and to measure the effect of this, we introduced a variable indicating the sequence when designing the questionnaire, as is customary in political and psychological research (split ballot testing) (Gaines et al. 2007).

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Survey participants for this study were recruited from students enrolled in undergraduate and graduate degree courses at Corvinus University of Budapest. The survey was conducted online. Given, that we wanted to explore the relationship of eight observed and two latent variables we used covariance based structural equation modeling (CB-SEM). Before analysing the paths and the fit of the SEM, we ran reliability analyses on the measurement model, to test whether the items skepticism and policy support are consistent with the respective latent variables. In our research we treated the answers given on the 7-point Likert scales as ordinal variables and for this reason we calculated the reliability measures from polychoric correlations, rather than Pearson correlations, and used diagonally weighted least squares (DWLS) approach that is understood to work best with this kind of data, and we also used the validity indicators obtained with the adjusted calculation method matching the ordinal variables.

The results of our survey showed that skepticism towards the coronavirus has considerable predictive power regarding the support for preventative epidemiological measures. Our findings suggest that policy makers have to pay attention and react to counterarguments when formulating preventative epidemiological measures. The measurable effect of the order of questions supports this idea as well: when rating skeptical arguments preceded the questions about the support for the preventative epidemiological measures, respondents tended to believe less in these measures.

The two worldviews we examined (individualism and social solidarity) were important influencers of COVID skepticism in our model. A high level of pro-social attitude decreases people's doubts, while an individualistic worldview tends to increase it. Social solidarity can, at the same time, be a direct predictor of support for preventative epidemiological measures as well. This means that those people can also support preventative measures who are skeptical about the coronavirus, but they have solidarity for the rest of society. In this study we also found that direct and indirect experiences with the COVID-19 disease have diverse effects on the rejection of the coronavirus. For instance, if a family member or a friend contracts the disease, it will lower the level of skepticism, while direct experiences tend to increase it. In our view,

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Study IV. SEM predicting the support for epidemiological preventive measures
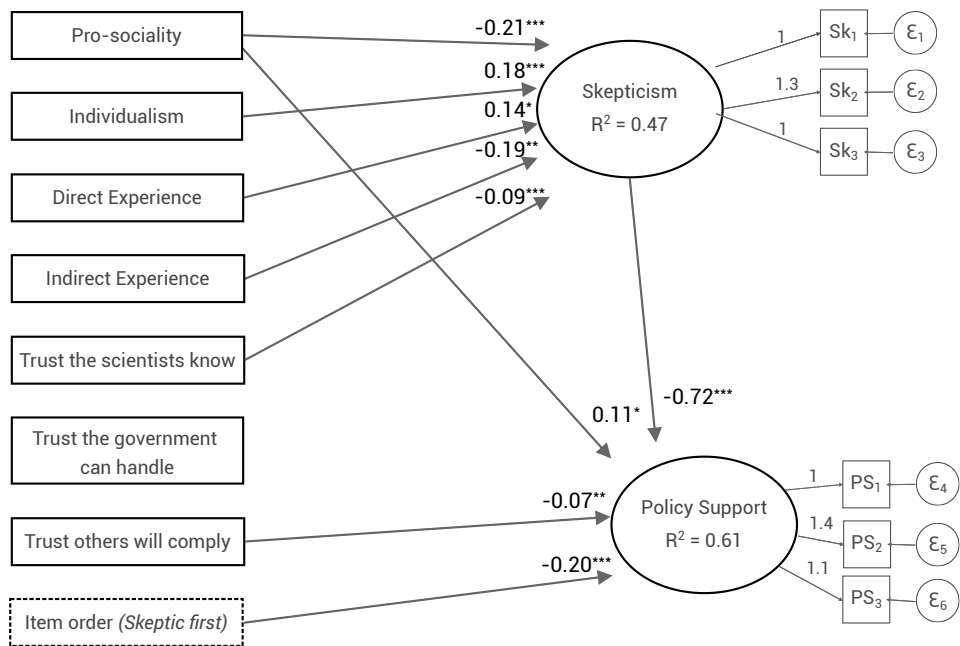
Figure 4.

these differences can be explained by the make-up of our sample, because young adults tended to exhibit only mild symptoms. The relatives of our subjects, however, were more likely to be older, and the more severe course of their illness could leave a greater impression on our young respondents.

A lack of faith in scientists is an important source of COVID skepticism. Those who think that scientists do not or only partially possess relevant knowledge about the coronavirus are more susceptible to skeptical opinions. The contribution of faith in scientists to the greater support of policy measures can only be partially explained by its effect on COVID skepticism. Thus, those who are less skeptical about the COVID-19 epidemic will continue to support preventative measures if they have trust in the word of scientists. Contrary to our initial assumption, we found a negative association between trust in others and policy support. Meaning, when people trust others less, they demand stricter regulations to curtail the spread of the virus and guarantee their own safety, and they want the government to enforce such regulations.

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Study V. Sampling and course of COVID-19 in the country
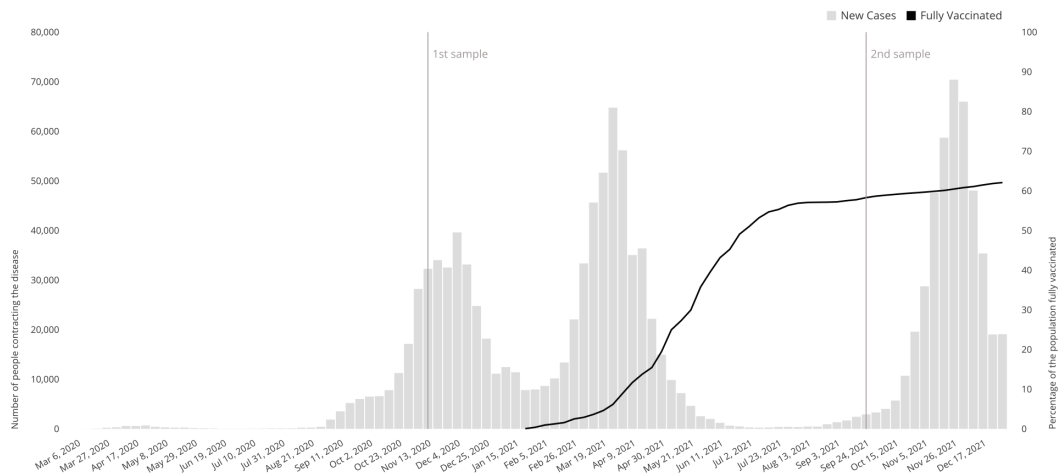
Figure 5.: The figure shows the new cases of COVID-19 and the cumulative proportion of the fully vaccinated population from early 2020, when the pandemic reached Hungary, throughout the first four waves until the end of 2021. The time of data collection for this study is also annotated on the figure.

Study V. COVID-19 skepticism and the perception of risk

For this study we used the same survey as for Study IV, and partially the same sample as well, but also performed a repeated data collection almost a year later with research participants recruited the same way. So, data collection took place between the 16th and 24th November 2020 (the rapidly escalating part of the second COVID-19 wave), which then we repeated with the same set of items between the 20th and 27th September 2021 (the beginning of the fourth COVID-19 wave). It is also an important difference, that in this study we focused on the relationship between Covid skepticism and the perception of risk.

To analyze the data in this study we fitted linear regression models for both samples using the index variables for risk perception and skepticism. We applied the regression model first on the conceptualized mediator variable (COVID skepticism) with a reduced set of antecedents. The assumed predictors of COVID skepticism were the respondent's worldview, experience with the virus and trust in scientists' variables as

predictors. In a second step, we regressed our main dependent variable (risk perception) on the mediator (skepticism), all of the mediators predictors and the remaining surveyed antecedents; trust in others, trust in government and gender. We ran model diagnostic steps (checking VIF scores, conducting Durbin-Watson test, confirming normal distribution of residuals etc.) to confirm a good approach. As part of the mediation analysis, we performed a simulation separately for each of the five variables assumed to be mediated by skepticism. For the mediation analyses and the relative variable importance calculations we applied bootstrapping methods with 5000 simulations to get robust estimates and the 95% confidence intervals.

In our study we saw the risk perception of young adults slightly decrease from the second to the forth wave in all measured aspects except the seriousness of the sickness. Vaccination has become widely available in 2021, people have become more and more familiar with the virus and over time they are likely to develop 'worry fatigue'. These factors likely contributed to the lessened fear from the virus. We also observed a shift between the two samples regarding which variables are associated with risk perception in our model, but skepticism and pro-sociality proved to be very important predictors in the second and the fourth waves alike. Meanwhile, trust in scientists and the worldviews of the individual were also consistently associated with risk perception indirectly, through skepticism.

From mediation analysis we found people with a strong pro-social attitude tend to be less lenient toward a skeptical stance, and also, perceive the risks to be higher, while individualistic worldviews are more prevalent among those with a skeptical stance, which then leads to lowered risk perception. Trust in scientists is strongly associated with COVID skepticism, and through that, risk perception as well. Skepticism is negatively associated with trust in scientists, meaning, those who believe that scientists possess the necessary knowledge related to the coronavirus, are less receptive to skeptical arguments. We find from the repeated nature of our survey research that the way trust in scientists and government is associated with risk perception is influenced heavily by the discourse at the time of data collection. The messages con-

Table 1: Study V. Relative importance of variables predicting risk perception

	2020 November		2021 September	
	Pct. of R^2	Conf.Int.	Pct. of R^2	Conf.Int.
Skepticism	33.8%	[22%-51%]	43.2%	[32%-59%]
Individualism	9.0%	[4%-20%]	3.3%	[2%-6%]
Pro-sociality	17.3%	[9%-31%]	30.6%	[19%-48%]
Direct Experience	2.7%	[0%-10%]	5.4%	[1%-16%]
Indirect Experience	7.3%	[1%-19%]	2.4%	[2%-9%]
Trust Scientists	8.4%	[2%-20%]	4.5%	[1%-15%]
Trust Government	5.9%	[1%-17%]	1.6%	[0%-8%]
Trust Others	1.7%	[0%-8%]	8.6%	[2%-21%]
Gender	14.1%	[6%-28%]	0.4%	[0%-3%]

Note: The table reports the relative variable importance in the regression model fitted with the risk perception index as the dependent variable. The percentages representing relative importance are normalized and attribute for the total R-squared (0.223 and 0.233 respectively) explained by the model. The represented confidence intervals correspond to the 95% level.

veyed by the government and scientists during the second wave were rather different and this translated to opposite influence in our model in the first sample. While during the fourth wave the government choose a respected professor to convey its main messages and that translated to the trust in government not to be associated with risk perception anymore, while trust in scientists became a more powerful predictor of skepticism

Direct and indirect experience with the disease had opposite effects on COVID skepticism. Also, the direct experience became a better predictor as more people got the disease by the second sample, but indirect experience lost relevance in the model as it got ubiquitous. Those who had a family member or a friend contracting the virus perceived higher levels of risk and were less skeptical at the time of the second wave, but this effect disappeared a year later during the fourth wave. Having a direct experience is associated with increased risk perception and increased skepticism, but it's quite peculiar as we know the latter should come in hand with lower risk perception.

During the second wave of COVID-19 in Hungary our results show that female participants perceived COVID-19 related risk higher than males, which was an expected result based on previous findings of risk research, but this gender effect disappeared in our sample one year later. One explanation to this could be the accumulating information about the disease, and that serious consequences of it can be increased by genetic features and could not necessarily be avoided with generally good health. We learned that the actual risk of death from COVID-19 was higher for men (Li et al. 2020), therefore the perceived risks among men could have adjusted accordingly. By the time of the fourth wave the gender effect might have been neutralized by the expanding knowledge on the hazards of COVID-19 and the beliefs that formed around it.

1.4. Usability of the findings for policymakers and other researchers

The empirical studies in the dissertation present plenty of findings that can by utilized by policymakers. It is shown that revealing the purpose of the policies and the influencing attempt (despite the good intentions) can reduce the support of behaviorally informed policies (and possibly other types as well). This cautions policymakers on the application of nudge and calls for further research about properly applying the policies. Ways of implementing a more ethical approach could be separating the decision environment and purpose communication, or only trying to apply nudges for

cases where is wide consensus among members of the public.

The findings demonstrate that support for a type of policy is always influenced by the field in which it is used. If policymakers play with the contrast effect among different types of policies by proposing a stricter ones just to gather support for other types, that would not work universally. This also has implications for policy research, questioning the assumption made by most studies that support for domain-specific nudges can be simply aggregated.

The research performed in the context of the pandemic pointed out the tricky situation of governing politicians. People generally support nudges over strict regulations but this is not true among those, who perceive a high risk in the given situation. Also, if the government tries to communicate the effectiveness of their containment measures and convey messages saying 'things are under control', they can simultaneously lower the public's risk perception and make the needed interventions unwelcome in their eyes. In contrast, if the perceived risk is high, it enhances the legitimacy of the introduced measures.

Based on our findings regarding experience: that actually catching and recovering from the virus decreases the support, while seeing family members getting sick increases it, authorities ought to emphasize the protection of family members, friends, and vulnerable members of society by complying with preventive measures in their risk communication, instead of underlining the inherent dangers of catching the virus. Covid skepticism's important role in belief formation and its influence on both risk perception and policy support makes it must-address in risk communication strategies. Policy makers have to pay attention and react to counterarguments when formulating preventative epidemiological measures, and bear in mind that these attitudes are probably deeply routed in the peoples worldviews. Since the social support for preventive measures closely correlates with rule-following (Franzen and Wöhner 2021), the spread of skeptical opinions can hinder effective protections against the pandemic.

Prosocial attitudes and trust in scientists are two key components than can be relied

on for propagating compliance with preventive policies. Utilizing this can be important for policymakers and governmental actors in charge of communications: in the fight against an epidemic, it is worth emphasizing the values of social solidarity, the respect for the interest and rights of others, increasing the common good, as well as mutual help and responsibilities. Also, the credibility of virologists and epidemiologists is a prominent factor to increase the acceptance of anti-pandemic measures.

1.5. Potential research directions for future nudge research

1.5.1. Nudgeability

The seminal book on nudges by Thaler and Sunstein (2008) has generated myriads of studies in this field, but it is still not clear which people are more susceptible to nudge influence. The concept of nudgeability was introduced by de Ridder et al. (2022) to better understand this dilemma. They created an integrated framework to incorporate several factors such as transparency and awareness, preexisting preferences, and modes of thinking that can influence someone's nudgeability. In the same time, they also admit that other factors may also play an important role, but they should be found end empirically tested in a more comprehensive way in the future.

1.5.2. Personalized nudge

Peer et al. (2020) suggests that so-called personalized nudges can boost efficiency of behavioral interventions up to four times in some specific domain (pushing people towards using stronger and safer passwords). They also argue that nudges are usually designed with an "average" decision maker in mind, but one-size-fits-all nudges do not exist in the real world. Personalizing nudges, however, may bring new challenges to policy makers (Mills 2022), hence future research should explore how to keep balance between personalizing nudges and adopting universal principles when designing decision situations. Research should also determine under what conditions

and in which domains personalized nudges are more effective and when they should
be avoided.

1.5.3. *Nudges across cultures*

Numerous studies demonstrate that social acceptance of nudges vary across cultures – it is evident that certain nations embrace nudges more than others (see for example Reisch et al. (2017); Dogruel (2019); Sunstein et al. (2019). Nonetheless, the effectiveness of nudges across cultures are rarely investigated. Although the landmark study of Johnson and Goldstein (2003) famously showed that countries with opt-out organ donation systems produce much higher donation rates than opt-in-regimes regardless the country of origin, rigorous cultural comparisons are seldom made, and sustained effects of globally applied nudges are rather unknown (Oliver and Ubel 2014). A global trauma like the COVID-19 pandemic can call attention to this research gap. Governments experimented with similar policy tools to reduce COVID cases and fatalities, hence comparisons are – with some limitations – feasible.

1.5.4. *Endurance of nudges – Does habit formation occur?*

Nudges are often accused of having limited long-term impact on decisions they are supposed to change, hence tenacity of nudges is questionable. Nudges are often proved to be efficient when the manipulation occurs, however, the habit formulation process is often missing (or not tested at all), subjects are not necessarily accustomed to the desired behavior. When, for example, people are nudged to make more sustainable or healthier choices, it is not clear whether these choices will be sustained later when the stimuli disappear. Gravert and Collentine (2021) for example, argue that simple nudges (in their case, social norms) are not enough to generate sustainable travel behavior (public transport usage) in the long run, and economic incentives seem to be a more promising policy option. Yet, 'stickiness' of nudges is a critical factor since in most cases policy makers and decision architects want to have long term im-

pacts of their policy instruments, but research in this field is rare and the phenomenon is poorly understood (Zimmermann and Renaud 2021). Therefore, it should be tested under which circumstances the impact of nudges endure and change habits in the long run.

1.6. List of publications included in the dissertation

All of the research I conducted and present in this document I performed together with my doctoral supervisor, Szántó Richárd (and him alone). We have developed the findings of our research as academic journal articles, and for this reason they have an internal consistency in their narrative. I compiled these studies in my dissertation without re-editing, and present these studies in the form as they were - or planned be - published. Each of the presented papers are the fruits of our equal contribution.

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2. Study I. The inner workings of choice architecture. The theory, mechanisms and criticism of nudging

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Translated from the original Hungarian by the doctoral candidate. The English version completely matches the content of the original

Abstract

Richard Thaler and Cass Sunstein's book on nudge was published barely ten years ago, in 2008, but the defining work has now resulted in numerous studies, scientific reports about experiments in decision planning. More and more conferences are being held on the topic, and some countries, such as Great Britain, have even made nudges a part of government policies. A significant part of the large number of researches published on the subject is nevertheless critical of the new tool, the concept of nudge is very soon in the midst of political, philosophical and ethical debates. In their article, the authors systematically explore the literature surrounding the nudge, classify its different forms of implementation, present the policy implications, and address criticisms on the use of nudges.

2.1. Introduction

The term 'nudge' originally means to poke or push somebody, while in Richard Thaler and Cass Sunstein's interpretation it means steering or encouraging decision-makers in a certain direction. The nudge, although it directs decision-makers towards a pre-defined decision, still allows for the freedom of choice. Thaler and Sunstein (2008), in their book on nudges, also introduce the term choice architecture, which means that when creating situations where decisions are made, we should pay attention to the traps and biases originating from behaviour science's rational choice theory. Due to their limited cognitive abilities and the complexity of the environment, people are not always able to make rational decisions (Szántó 2011). Choice architects, therefore, formulate choice situations in a way that decision-makers should make decisions that are favourable for themselves. It is important to highlight that nudges do not operate with significant economic motivators and do not limit decision-makers in choosing an alternative that is dear to them (Thaler and Sunstein 2008). Based on this, for instance, legally forbidding smoking at bus stops is not considered a nudge, but placing dissuasive images on tobacco products is, since the latter does not limit customers in purchasing tobacco products, but it tries to subconsciously discourage them from practicing their harmful habit.

The present paper discusses studies published on the topic of nudges since 2008. On the one hand, we attempt to shed light on nudges' theoretical background, as well as to illustrate their modes of action through practical examples, and we also discuss their relevance in policy. The last section of the paper considers the criticism the use of nudges habitually elicits.

The methodology of literature review

This literature review is based on a selection of 129 articles, which were obtained as results of a query we conducted in the EBSCO database. We searched for peer-

reviewed academic journal articles published between 2008 and September 2016 that contained the keywords "nudge" and "policy" in their abstracts. After reviewing the abstracts, we filtered out 20 papers which were either irrelevant to our research, or interpreted the concept of nudges too widely, or they merely mentioned it in passing. Furthermore, 30 other papers were also excluded from the review, since they covered such wide-ranging topics that they did not fit this comprehensive synthesis. The primary focus of our synthesis was those applications and phenomena which might make nudges effective, and we also focused on academic papers discussing the policy application of nudges or on the concerns regarding the use of nudges.

The classification and acceptance of nudges

We have seen several categorizations of nudges in the literature which would suggest some sort of a dichotomy. For instance, Jung and Mellers (2016) distinguish between system 1 and system 2 nudges when they examine what kind of nudges are most accepted by decision-makers. We use the distinction of system 1 and system 2 nudges based on the work of Stanovich and West (2000), which was popularized in economic circles by Kahneman (2011): the former refers to the brain's automatic cognitive processing mode, while the latter refers to deliberate, thoughtful, conscious brain activities. System 1 nudges take advantage of the trap of our quick, intuitive decisions (for example, by a deliberate placing of healthy and unhealthy food items on the shelves of school cafeterias), while system 2 nudges are based on the fact that people make more thoughtful, considerate choices when they are in possession of the appropriate information (e. g. when they are aware of the nutritional value of the food items they consume). Research carried out by Jung and Mellers (2016) highlights the fact that people are a lot more accepting towards system 2 nudges and they tend to, for the most part, reject system 1 nudges affecting automatic cognitive processes. The classification by Felsen et al. (2013) is similar to the system 1 - system 2 pairing: they differentiate between open and hidden nudges and come to the conclusion that people prefer open nudges which affect conscious thinking, as opposed to hidden nudges

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influencing subconscious mental processes. These revelations highlight an interesting paradox: it is possible that some people agree with certain seemingly rational goals with their thoughtful selves (e. g. losing excess weight), but they do not support others (e. g. the government) manipulating them with hidden tools – often with ones affecting their subconscious – in order to achieve such goals (Oliver 2013).

Baldwin (2014) suggests a different categorization of nudges by classifying those as first degree nudges which in no way influence the personal autonomy of the decision-maker, but they strengthen the possibility of reflective decision-making. These can be the simpler forms of information transfer or sending reminders (e. g. "You have three weeks to file your tax returns"). Second degree nudges are those measures which build on the traps of individual decision-making and thus direct decision-makers towards choices that are more favourable for themselves. Such an example could be the so-called opt-out organ donor system, which is based on tacit acquiescence. In the case of second degree nudges, the extent of reflection is necessarily smaller, but the decision-maker still has room for consideration. According to Baldwin, the point of third degree nudges is that the creator of the nudge manipulates the decision-maker in such a way that wishes to block even the possibility of reflection, most frequently with some emotional impact. Such a case would be featuring shocking images, e. g. those of lung cancer patients, on the packaging of tobacco products, or they try to steer people towards healthier eating habits via subliminal messages.

Yeung (2016) views nudges as possible features in the deliberate architecture of choice environments. In Yeung's interpretation, forcing and encouragement – while they may be parts of the choice architecture – cannot be regarded as nudges, since in the case of the former, the decision-making individual makes their choice while being aware of certain threats, while in the latter case they choose an option in order to achieve some sort of a favourable outcome.

2.2. Nudge catalogue: the nudges' modes of action

Numerous researchers have attempted to provide a catalogue of nudges by formalizing the elements of the nudge toolkit. In the following, we are going to introduce a section of these formalizing attempts based on the work of Korobkin (2009), Blumenthal-Barby and Burroughs (2012), Sunstein (2016), Grüne-Yanoff and Hertwig (2016), Hollands et al. (2013) and Li and Chapman (2013). Bases on our literature review, we are presenting a practical realisation, an illustrative example for each type as well.

Defaults

Defaults are probably the most wide-spread and most frequently discussed type of nudges, and they are based on the assumption that decision-makers will not necessarily change the default option offered to them, therefore choosing the starting position may be key (for example, in designing pension schemes). Giesen et al. (2013) put this method into practice and they found that our eating habits can be significantly influenced by the existence of the default option. When buying a burger menu, subjects would choose a small or large portion of fries depending in which one was the default option. Research conducted by Willis (2013, 2014) has, however, indicated that the impact of default options may be different in different situations, their "stickiness" may be influenced by the transparency of the choice environment or by the strength of the decision-makers' preference. Mazar and Hawkins (2015) have found, however, that by using defaults, honest behaviour can be encouraged as well.

Different forms of disclosure

Disclosing information to decision-makers appears in several nudge catalogues, but they often overlap with other types of nudges. Such examples can be food labels, or the 'look right' signs in London. Scrinis and Parker (2016) have found in their research that food sorting labels such as the icons resembling three-colour traffic lights

in the United Kingdom, or the use of stars in classification can steer consumers towards healthier eating, but the use of such signs can distort other information featured on the packaging.

Framing

This type of nudges takes advantage of the phenomenon that people will react differently to the same choice environment if it is worded differently: the same consequences can appear as a gain from one perspective and as a loss from another, but experience shows that we tend to react more sensitively to losses than to gains of the same proportion; this phenomenon is called loss aversion. Avineri (2012) examined the perceived differences between different modes of transportation, from the perspective of environmental awareness. When two modes of transportation with vastly different carbon dioxide emissions were compared and the question regarding the mode of transportation was phrased as a gain (they would pollute the environment less with this vehicle), there was hardly any perceivable difference in the answers, however, in the opposite case (they would pollute more with this vehicle), participants perceived the options as distinctly different. This shows us that loss aversion can be witnessed even in the case of using public goods (clean air), and phrasing a question can have a great deal of influence on the perception of the question.

Incentives

Different monetary and non-monetary incentives can directly influence certain decisions, but several researchers question whether these interventions can be seen as nudges at all (cf. Yeung (2016) argument). These modes of action, however, can undoubtedly be very efficient. Haydock (2014) notes, for example, that by determining the price of alcohol products, British health and safety policy uses these tools more and more boldly.

Emotional associations

This group of nudges is based on the idea that novel impacts that are spectacular or relevant to the individual can elicit such emotional associations which can significantly influence decisions (such as the dissuasive images placed on the packaging of tobacco products) and they can overlap with other nudges, for example, with different types of information disclosure. Czap et al. (2015) attempted to persuade farmers working along the same river to use sustainable farming methods by showing farmers along the upper part of the river the damages their activities cause along the lower part of the river. The research has found that this empathy-based method is less efficient than monetary incentives, but when the two are used together, they can strengthen each other's impact.

Social norms

The behaviours and choices of others and reference groups can have a major impact on the behaviours and choices of the individual, so raising awareness about them can prove to be a very effective nudge for the individual. By conveying and presenting norms, we can urge the decision-makers to internalize and accept them. Bell et al. (2016), in their exploratory analysis, examined what influences farmers the most in their decisions about spraying for parasites and leaving the land fallow, from the perspective of environmental awareness. They found that the social factor was the most significant, that is, individual choices are influenced more by other farmers in one's environment than the farmer's own situation and character.

Priming

By priming an individual, we can influence the decision-maker's response to a stimulus by conveying or evoking another stimulus prior to the decision. This stimulus can be realized below the sensory threshold as well. A study by Blumenthal and

Turnipseed (2011) highlights that the locality of polling stations has a significant impact on the votes cast. Polling place priming can be outstandingly significant in the case of polling stations set up in churches, which can evoke the voters' conservative and religious values. In Blumenthal and Turnipseed's opinion, decision-makers do not appropriately consider this subconscious effect, which can endanger the freedom of expression.

Personal commitment

Experience has shown that, in general, individuals endeavour to act in accordance with their publicly made promises and commitments, which can be utilized in the application of nudges (e. g. public promises made about weight loss or giving up harmful habits). Research carried out by Shu et al. (2012) has shown that such simple changes such as signing one's tax returns at the top or at the bottom of the form can achieve dramatic changes in the honesty of taxpayers. When taxpayers are required to sign at the top of the form, personal commitment can be elicited, which, in turn, will encourage the taxpayer to be more honest in filling out the form.

Prompting an active choice

It can endanger the alternative of the default option if we prompt decision-makers to make an active choice. In cases when entrenched habits or procrastination can prove to be real dangers, or maybe the designers of nudges do not have all the necessary information, we can achieve a positive effect by prompting the decision-makers to make an active choice. Milkman et al. (2011) used a simple test to validate the impact of this mode of action with nudges about the flu vaccine. One-third of a company's employees were directly asked in email to provide the date and time when they would like to be vaccinated for their own protection. These people went to get the vaccine in greater proportions than those who were merely informed about the possibility of the vaccination (control group). A third group consisted of those who were also

directly approached but they only needed to provide the day of the vaccination. The proportion of those in this group who eventually turned up for the vaccination was almost imperceptibly higher than that of the control group, which leads us to the conclusion that the more specific answer is required in the choice environment, the bigger the respondent's commitment.

Attention and cognitive accessibility

Directing the decision-makers attention to certain pieces of information or highlighting that information can result in a change of behaviour. For instance, if the rate of tax levied on alcohol products is displayed on the price tag, it effects alcohol consumption negatively. In their study, Elbel et al. (2014) examined how data presented in different ways influenced the decisions of those needing medical care (including those individuals who did not have health insure). In the course of the study, most subjects accepted the viewpoint towards which the researchers steered them by presenting the data in a certain way.

Positioning options

The presentation and spatial placement of options available to the individual can also influence decision-making. The placement of food items in school cafeterias or the conscious design of restaurant menus can steer people towards healthy eating. Wong et al. (2015) studied how the placement of beverages with and without added sugar in a shop affected the purchase of said beverages. They found that storing beverages in an unusual way (in a frequented place, at ex-level, in a refrigerator) increased the sale of beverages without added sugar by 2.8 times than when they were storied in more usual, less visible locations.

Taking advantage of temporal inconsistencies in decision-making

Individuals tend to overestimate the advantages of their present consumption as opposed to future advantages, therefore they are less likely to save money for their retirement. If, however, they compare two future states, the proportion of excessive discounting decreases, so when it comes to decisions about savings, it is worth urging decision-makers to compare short-term (e. g. within a year or two) and long-term (retirement) plans for expected consumption. In a paper examining the changes in the types of pension schemes, Orenstein (2011) observes that the financial crisis stopped the trend of private pension schemes. To make up for this and to achieve the appropriate private savings, policy makers turned to nudges. In general, we can say that in many cases complex and complicated processes keep people from making such desired decisions which would improve their well-being, so in many cases the mere simplification of choice environments can have the effect of a nudge. Besides, delays can also prove successful: these nudges steer decision-makers in the direction of making their decisions in a calm, level-headed state instead of making spur of the moment decisions. However, we did not find specific examples in the reviewed literature for the latter two types of nudges.

Although we have found examples for the design of several nudges, in many cases we can see that the targeted individuals will react in different ways. Some are a lot more sensitive to nudges, while other are less affected by this kind of influencing (Goldin 2015). Individual differences are highlighted by empirical research as well: more empathetic subjects are, for instance, more accepting towards nudges, while individualistic people do not support nudges, presumably in accordance with the notion of a state interfering less in the life of the individual (Jung and Mellers 2016). An interesting result indicated that people in general tend to think that others are more easily manipulated by nudges than they are – this is the so-called third person effect. Besides this, Cornwell and Krantz (2014) have also shown that the acceptance of a policy is higher if its wording refers to people in general and not to the subject,

regardless of the fact whether the answer needs to be justified, either in the case of nudges or in the case of traditional incentives. These distinct reactions clearly show the importance of experiments in the formation of public policy (John 2013).

2.3. The role of nudges in the formation of public policy

The reviewed literature suggests that influencing citizens with nudges has been a conscious addition to the toolkit of policy makers. There have been a number of contrary opinions as to whether this is ethical or permissible, which we are going to recount in the section* on criticism. Different authors interpret this addition to the toolkit differently and reflect on the application of nudges. There are some who think that the concept of nudges gives us a new, independent tool which we can use instead of other, traditional methods when it seems more appropriate. Other studies suggest that there is potential in the use of synergies, that is, using the tools together to achieve the desired goal. There are several papers, however, which, instead of exploring potential applications, debate when influencing by nudges will be successful, what are the circumstances that define its efficacy and durability.

Competing or complementing strategies

The government of the United Kingdom has created a "Nudge Unit" in order to assist the government's goals, and, as a result, a number of measures influencing choice environments have been introduced. A paper by Quigley (2013) highlights that the nudges' penetration has pushed other measures to the background, especially in public healthcare. The paper presents how the modes of actions making the application of nudges possible can be used to an advantage in decisions that occur in healthcare.

In their paper, Mols et al. (2015) argue that the nudge as a new, independent form of governance has appeared beside the tools of hierarchies, networks and persuasion. However, they highlight that a critique of governance along the lines of nudges is

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that this method cannot achieve long-term changes in behaviour, since these measures hardly move forward the internalization of new social norms. In their opinion, a measure can be effective if people are addressed not as individuals but as members of a group who represent the norms of said group.

For those considering the use of nudges, it is important to compare how effective are nudge-based methods in achieving the desired outcome, in comparison to traditional or usual policy alternatives. In a paper, Galle (2013) goes against those rejecting nudges because of their low impact and argues that both the application of nudges and the application of hard regulatory elements surpass the efficiency of the monetary incentive systems of taxes and grants, so it is worth using the former methods instead of the latter one.

Calo (2013) devises a unique division regarding the toolkit. According to Calo, regulations and legislation can be used in the formation of the environment just as more subtle influencing via nudges or the even less pressing means of 'full disclosure'. Calo posits that these three methods, which are very different in their application possibilities and significance, but which are all valuable in themselves, are the most efficient when used all together. While in the case of hard tools, such as legislation, there is a system of checks and balances which does not allow legislators to overstep their authorization, this system is absent in the case of nudges and full disclosures. That is why, when using subtler methods, we have to be careful to only promote the following of pre-existing social norms and the fulfilment of pre-existing desires.

Roberto et al. (2014) formulate a similar opinion in their paper on the importance of synergies. They argue that such traditional public health strategies as taxation and regulations have to be complemented by such measures that are based on nudges. In their opinion it is particularly important to carefully select the consumption environment in the nutrition of children, since people at a young age tend to make impulsive choices. Due to the ease of influencing people in the circumstances, their article provides definite directives for designing choice environments for young people.

A study focusing on a controversial topic also examines positive interactions. McCarthy (2016) studied the changes in social attitudes towards same-sex marriage and discovered that the impact of the combined use of policy reforms and subtler nudges is stronger than the impact of the two things separately. As opposed to Calo's (2013) paper, McCarthy claims that not only existing social norms should be reflected in the steps that the government takes, but makers of public policy should be progressive and proactive in their actions.

The debate on best practices

For makers of public policy, it is particularly important to further explore the conscious use of nudges as parts of the government toolkit, and, as a result, to take advantage of them in ever widening circles. Numerous experts, however, have recommend a more cautious approach and more careful planning. Michie and West (2013) criticize current practices regarding the influencing of human thinking and taking advantage of modes of action. In their opinion, interventions aimed at behaviour changes must be used in a considerate manner, and they recommend using the already existing results of psychological sciences. They highlight the application of such theoretical frameworks with which policy-makers can use nudges ethically and effectively. Milne (2012) also calls attention to an already existing theory – the Rose Hypothesis or prevention paradox, from the field of prevention – in the use of nudges as well. According to the Rose Hypothesis, it is more effective to try and achieve small changes in the behaviour of many instead of trying to achieve big changes in the case of the high risk population. Therefore, the paper emphasizes the importance of launching comprehensive initiatives, which, in Milne's opinion, can only be realized by the cooperation of NGOs and governments.

The relevance of the wider environment

Often, nudges are harder to use than we would think. People's environments, to a large extent, determines how a given measure will affect them. Therefore, it is important to fully familiarize ourselves with the environment before attempting to intervene, and, on the other hand, we also need to know that it is harder to succeed in a heterogeneous group.

When comparing people of different cultural backgrounds, several papers came to the same conclusion, that the same influence works differently in different environments. Morgan et al. (2015) studied the attitudes of different ethnic minorities in the question of their willingness to become organ donors. Their results have shown that we cannot neglect an individual's prior disposition in the use of nudges. One's ethnic background has an effect on the person's awareness and information regarding organ donation and it also shapes people's attitudes. A paper by Higham et al. (2016) also discusses differences between groups belonging to different cultures. They examined the relevance of ethnic background in four developed European countries and found that people in different countries had dissimilar attitudes towards regulations and the acceptance of nudges. While Norwegians preferred influencing by way of taxation and regulations, in the other countries people were more positive about the use of "subtler" tools. A third example for studies examining different cultures deals with even further cases. Borovoy and Roberto (2015) compared the fight against obesity in the United States and in Japan and found that nudges had more of an impact in the Japanese environment. Their explanation posits that Japanese culture is more compliant and homogeneous, where it is easier to elicit the appropriate effect.

We mentioned earlier that the most documented uses of nudges come from the United Kingdom, therefore, it is no wonder that several of the reviewed papers discuss the question as to why the impact of measures introduced in the United Kingdom is uneven (Jones et al. 2011; Pykett et al. 2011; Jones et al. 2014). These articles establish that beyond cultural differences, we have to explore political and cultural

issues along the lines of other factors influencing attitudes concerning the acceptance and impact of nudges. Jones et al. (2014) highlight that the strength of the concept of nudges is that they can be inserted into policy-making along the lines of different ideologies, since both Labour and coalition (right wing) governments have used them. The authors warn, however, that without geopolitical surveys and mapping different impacts in different groups, over-generalizations in political measures can lead a loss in significance and relevant goals can be hollowed out.

The criticism on the use of nudges

With the emergence of the concept of nudges, critical voices emerged as well, although Thaler and Sunstein (2008) attempted, when laying down the conceptional foundations of the idea, to tackle such criticisms by dedicating an entire chapter to possible objections. The majority of criticisms come from the fields of moral philosophy and political science, which we are going to attempt to briefly summarize below.

Great narrative criticism. The majority of nudge critics argue that nudges – although they may provide a solution for some social issues – do not provide general solutions for fundamental, large social issues. For example, we can use nudges to convince people to consume less electricity or collect their household waste selectively, but these steps in themselves will not solve the global issues of sustainable development, and most people will still be unable to consciously reflect on these fundamental questions (John et al. 2009). We can regard the problem of obesity as the consequence of a series of bad personal choices (which we can therefore treat with nudges), but this narrative neglects the biological, social and cultural reasons behind obesity (Baldwin 2014). What is more, certain nudges will give policy-makers a false sense of security by making them think that they have achieved real social change (John et al. 2009).

According to Room (2016), people stick to their tried and trusted methods (the trap of the status quo) or they asses risks incorrectly because there is too much uncertainty and ambiguity in the world surrounding them. Therefore, Room suggests, the job of

governments is not to take advantage of these traps in the formulation of policy but to decrease this excessive uncertainty.

The criticism of paternalism

One of the main sources of criticism of nudges comes from the general aversion towards paternalism. Thaler and Sunstein (2008) describe the concept of nudges as libertarian or soft paternalism, which is different from coercive or hard paternalism in the fact that it allows the possibility of choice to the citizens. We can, therefore, differentiate between two strands of paternalism: (1) in the case of hard paternalism, the external actor (e. g. the state) can force the decision-maker, even against his/her wishes, to make a certain choice (e. g. the mandatory wearing of crash helmets), (2) while in the case of soft paternalism, the third party attempts to steer the decision-maker towards a choice that is deemed better, without coercion (Borenstein and Arkin 2016). Paternalism, regardless whether it is hard or soft, is necessarily accompanied by the re-distribution of public goods, and since people's preferences are not homogeneous, for some, this re-distribution may generate welfare losses, since the state will never fully possess all the information necessary to formulate effective public policies (Schnellenbach 2012).

Many find it doubtful whether we can even objectively define the concept of welfare, that is, whether the state – or its actors – know what the citizens benefit from (Baldwin 2014; Hansen et al. 2016). Although we usually accept it as a fact that the consumption of fruit is good for children or that the tetanus vaccine is essential for young people, we are not necessarily in possession of conclusive evidence beyond reasonable doubt (Blumenthal-Barby and Burroughs 2012). Therefore, we can state that the proponents of nudges have strong assumptions about the makers of public policy (and that of nudges), since they believe that state actors always have appropriate information about the citizens and their rather diverse goals, and, as a result, they will not fall into the trap of irrational decisions. These proponents also suppose

that decision designers are always benevolent, that is, they are always motivated by a wish to increase citizens' welfare (Grüne-Yanoff and Hertwig 2016). It is not hard to realize that these assumptions can hardly be fulfilled in reality. Lodge and Wegrich (2016) call this phenomenon the paradox of rationality, in which the creators of nudges build on the limited rationality of individuals, but they fail to reflect on their own limitations.

According to Cornell (2015), however, the problem with paternalism often is not that it is coercive or that we do not know what kind of interests lie behind a certain agenda but because it is often expressly offensive for individual decision-makers since the underlying message is that citizens themselves cannot recognize the choice that is favourable for them. Standing (2011) presents a similar argument by saying that nudges infantilize citizens and take away their right to autonomous decisions. The attitude of "I know better", however, does not always carry this underlying message. We can, for instance, encounter diverse versions of paternalism in the field of public health (mandatory vaccinations, screening tests, the mandatory use of crash helmets for motorcyclists etc.), which are more or less accepted by people (Verweij and van den Hoven 2012), so the legitimacy of nudges might be greater in these areas. Oliver (2013), however, argues that nudges need to be a lot more visible to people and they can only be used if citizens would otherwise cause harm to others.

The ethical criticisms

Maybe the highest proportion of critical opinions regarding nudges is constituted by ethical concerns. Some critics attack the mechanism which allows state actors to influence citizens often in ways that lack transparency, that are manipulative and that affect their personal freedoms and autonomy. Other critics, on the other hand, criticize the content of nudges as well (which we indicated in the previous section), that is, they raise the question whether state actors have the right, the knowledge and the competence to dictate what is good for the citizens (Ashcroft 2013; Borenstein

and Arkin 2016).

Although many have attempted to disentangle the categories of persuasion, manipulation and coercion, literature offers a wide range of definitions and we encounter a similarly diverse spectrum if we try to define the concept of autonomy (Sawicki 2016; Saghai 2013). According to Kantian moral philosophy, the value of autonomous decisions depends not on the consequences of those decisions but on the decisions themselves and on the intention of the decision-maker. From this perspective we can claim that consequences do not necessarily justify the rightness of a decision, that is, the argument posed by nudge proponents that the use of nudges, on the whole, increases the well-being of people is not satisfactory. If, however, national legislation requires people to separate their household waste, but a citizen only complies with the legislation to avoid penalties and not out of his/her personal conviction, we might ask how autonomous his/her decision is. Research conducted by Lewinsohn-Zamir (2015) has shown that people only regard such decisions to be autonomous that were made as a result of coercive measures targeted at behaviour changes if that was accompanied by a change in personal preference as well.

In discourse on nudges researchers often differentiate between negative and positive liberties, and they frequently identify the latter as personal autonomy (Yeung 2016). As opposed to negative liberties, which mean that the decision-maker cannot do something as the result of an external coercive circumstance, the point of positive liberties is that the individual does not act as he/she would like to due to some sort of internal imperative (Mills 2013). In case of nudges, the negative interpretation of liberty is not infringed upon, since the choice is still given to the decision-maker. But in the positive interpretation personal liberties may be infringed upon, since the person does not make the decision on his/her own (Yeung 2016; Ashcroft 2013) but with the involvement of some external factor, that is, the person's autonomy is compromised. Bonotti (2015) examines the same question with regard to nutritional science. Some point out that it is not always obvious whether nudges really improve decision-makers' expected utility (Korobkin 2009). In some cases they may become more in-

formed (for example, if they receive easily comparable information about the costs of credit card ownership from credit card providers), but this may distract them from other important aspects (to use the previous example, from the quality of services attached to the use of credit cards).

The problems of manipulation and transparency

Nudges are, by nature, often not transparent – for example, if students were informed that the placement of food items was changed in the school cafeteria so that they should be steered in the direction of healthier food options, the impact of this measure would probably decrease or even disappear (Baldwin 2014; Oliver 2013). Due to the hidden nature of nudges, often it is not possible for them to become the subjects of policy debates. If the government forbids smoking in public places, different interest groups may object to it, the issue may become a conversation topic in society, but a similar nudge that is not so obvious to people might not become a part of public discourse.

In the case of second and third degree nudges, there is a danger that if the manipulation is revealed, then the trust in social institutions will be compromised. If patients find out that they are being manipulated in their medication choices, their faith in doctors and medications may be shaken (Baldwin 2014). Nudges, at least according to their proponents, ensure the freedom of choice, but in some cases it is fairly difficult to avoid them. Therefore, many critics argue that governments should only interfere with individual decisions and "protect people from themselves," if they do it openly, such as in the case of enforcing the mandatory use of seatbelts for everyone (Oliver 2013).

Of course, not all nudges are equally manipulative. If people have the opportunity to "wriggle out" of nudges, and the designer of the nudge does not have manipulative intentions and does not want to influence people against their wishes, then we cannot talk about manipulation (Wilkinson 2013). The "option of wriggling out" has a partic-

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ular significance in the case of defaults, if evading the nudge is too costly, then we can question how ethical the given nudge is. An opt-out organ donor system, which can increase the number of potential organ donors in a country, can still be unfavourable to certain disadvantaged social groups (e. g. illiterate or homeless people etc.) because they cannot easily opt out of the system (Blumenthal-Barby and Burroughs 2012). What is more, if a nudge affects our subconscious, then there is no guarantee that we can evade it since we might not even be aware of the impact itself (Oliver 2013).

The dissuasive images placed on the packaging of tobacco products, however transparent they are to the individual, are still manipulative, since they do not affect the person's rational thoughts (e. g. by showcasing statistics about smoking-related deaths), instead, they take advantage of people's psychological weaknesses: they are based on the trap of availability heuristic, according to which when people estimate the likelihood of certain outcomes, they tend to attach more importance to the striking and easily accessible memories than to relative frequencies and statistical estimates (Schnellenbach 2012, 2016). It is still true even when the manipulation of dissuasive images is another manipulation, namely, a response to tobacco companies' advertising.

Saghai (2013) attempts to resolve moral dilemmas by providing a narrower definition of nudges than the original and emphasizes the retention of choice options for the decision-maker and the lack of essential control (that is, the nudge's creator fundamentally does not control the decision-maker's choice, the decision-maker can easily "wriggle out" of the nudge if he/she wants to). From this perspective, some classic nudges cannot be interpreted as nudges: for example, if somebody is led to believe by the generation of false childhood memories that he/she used to love asparagus as a child and thus the person is steered towards healthier food items, the option of evading the nudge is compromised, therefore, in Saghai's interpretation it cannot be regarded as a nudge. According to Welch (2013), however, this would narrow down the scope of nudges in such a way that was not the intention of Thaler and Sunstein, the creators of the original concept. Mills (2013) emphasizes that nudges must be transparent and

there is a need for constant monitoring so that we can prevent such causes for moral concerns as we have described above.

Practical problems

Several critics argue that the proponents of nudges disregard the fact that institutional and social environments can influence the success of nudges, as well as its intended and unintended effects. For example, a nudge urging people to collect their household waste selectively will not necessarily work effectively in disadvantaged areas (John et al. 2009), while an opt-out savings scheme can only be effective in such an environment where people have sufficient income to start saving (Baldwin 2014), while indicating the calorie intake on food packaging only makes sense if consumers are familiar with the idea of the necessary daily calorie intake (Huang and Baum 2012). Nudges may be, by all means, accompanied by different externalities, which creators have to consider when designing nudges (Desai 2011). If, for example, a nudge allows us to make people consume fewer unhealthy donuts, we might just end up increasing the demand for biscuits (Huang and Baum 2012).

When it comes to the aforementioned organ donation system, many people argue that presumed consent infringes upon individual freedoms, since it endangers the autonomy of the individual decision-maker and in such cases at least family members should be given the right to veto (Whyte et al. 2012). According to American surveys, some people are afraid that if they sign up to become organ donors, they will not receive such intensive care as those who did not volunteer to become organ donor after their death. Many people also distrust the fair operation of organ donor authorities (Bard 2012). Apparently, the trust in social institutions will also influence the success of a certain nudge.

In their paper, Amir and Lobel (2008) argue that the creation of nudges can be just as costly as the use of other, traditional government measures, since state actors have to continuously test the efficacy of the designed nudge program both on micro and

macro levels. Silverman and Hendrix (2015) present a similar argument: they think that nudge programs and campaigns designed to popularize vaccinations draw funds away from other public healthy initiatives. However, we have to note at this point that this argument goes against that often-quoted argument that the use of nudges (e. g. via the designation of defaults or framing) is more cost-efficient than other government policies (Li and Chapman 2013).

Nudge programs are not necessarily always compatible with other government schemes (Baldwin 2014). Mills (2013), however, contradicts this to some extent, since Mills argues that controversial nudge programs (e. g. organ donation) need to be supported by other instruments of governance. Moreover, John et al. (2009) go as far as claiming that the use of certain nudges might even strengthen broader social discourses about the issue (which somewhat contradicts what has been discussed on the issue of manipulation and transparency). Apart from critical voices, many support the use of nudges and numerous researchers attempt to provide convincing answers to the critiques discussed above. We have found counterarguments presented in literature to the arguments concerning paternalism, autonomy and liberty (Mills 2013).

2.4. Conclusion

Although the concept of nudges was conceived less than a decade ago in 2008, its triumphant rise seems to be unbroken. Our literature review shows that Thaler and Sunstein's (2008) foundational text has generated numerous new research topics since its publication, it has called into being several conferences and conference panels, and a number of countries have raised the issue of using nudges to the level of governance. We are aware of few other concepts which have had such a success in such a short time, therefore this level of success for the nudges is noteworthy in itself. However, the papers we have reviewed also show that the concept of the nudge is under constant attack, which is probably not by chance. The huge popularity of the idea has also amplified doubtful voices: the attacks on the nudge are based on grounds of prin-

ciples, morality and practical considerations. The majority of papers featured in the literature review articulate criticisms about the concept, which leads us to believe that it is probably imperative for the future success of the concept that the proponents of nudges give reassuring answers to the critics' concerns.

Based on the literature review, it is noticeable that many of the papers were concerned with examples from the United Kingdom, since this is the country which first raised the use of nudges to the level of governance. This is, of course, not surprising, but it raises the issue of cultural effects and also to what extent can we generalize the studies that have been conducted so far: although recently there have been attempts at comparative analyses, the number of these is negligible.

It is noteworthy that nearly two-thirds of those papers which examine the use of nudges in a specific area are concerned with healthcare. The overwhelming majority of these papers deal with healthcare issues in general or comprehensively, but some of the specific areas they touch upon are diets, nutrition and obesity. We have also seen a smaller but still significant number of papers about nudges concerning environmental issues, as well as pension scheme incentives. Every other topic came up only once or twice in the course of the literature review, so we can safely say that healthcare, environment protection and pension schemes are the three areas which are the most attractive to the use of nudges.

After reviewing the relevant literature, we can safely say that the topic of nudges will continue to provide ample material for researchers of choice architecture, and makers of public policy will also be increasingly curious about the concept of nudges.

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3. Study II. Support of nudges in wider policy context. A survey experiment

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Abstract

The research question in this study was whether public support for policies with subliminal nudges change, when people are more informed, i.e. consider the purpose and the alternatives. Using three experimental conditions, one serving as control, without giving more context on the policies, we modified the presentation of the nudges with two different types of framing: When the purpose of the policy is presented to the subject, and when different policy alternatives are also presented (all aimed for the same purpose). The considered policy alternatives were: regulation, positive and negative financial incentives, a subliminal and an informative nudge. In our opinion these considerations reflect best an ideal, real-life policy evaluation. The subjects were randomly split into three different groups (experimental conditions). In the first condition the purpose and the alternatives were not disclosed, and the assessment was only required on the seven policies using subliminal nudges. The purpose of the policies was presented to the second group before assessing the seven nudges, and the third group had to assess all five policies after considering their purpose. The main hypothesis tests show that while presenting the alternatives does not have a significant

effect, revealing the purpose of the policies decreases the support for the subliminal nudges. The differences in the support for the five policies confirm previous findings of general acceptance of nudges. It is interesting that although the positive financial incentives have great support in five cases (as expected), there are two policies that received little support. Our findings demonstrate that the generally high support of nudges withstand the wider policy considerations, although there is a risk of people feeling manipulated if the intentions of the policy is revealed. This does not help in stepping toward a more ethical practice and transparency around nudges. It also cautions policymakers on the application of nudge and calls for further research about properly applying and communicating behaviorally informed policies.

3.1. Introduction

The application of nudges in policymaking is widespread since it was elevated to a concious toolset status by Thaler and Sunstein (2008). Since then, successful projects in countries like the UK justified the viability of libertarian paternalism and its wide ranging fields of applicability. Success of policy interventions rely on more than politicians awareness and intent, however. It also depend heavily on the policies' support in the society. This created the need to assess public opinion about this type of choice architecture embedded in public policy. The groundwork has been laid down by the studies of Hagman et al. (2015); Reisch and Sunstein (2016); Jung and Mellers (2016), highlighting major differences in support for behaviorally informed policies based on individual and cultural traits, the type of nudge mechanism (e.g. system 1-2) or the applied field.

Nudges are defined as "... any aspect of the choice architecture that alters people's behavior in a predictable way without forbidding any options or significantly changing their economic incentives." (Thaler and Sunstein 2008, p. 6). Critiques often claim that nudges manipulate people's choices and they are paternalistic in disguise (Hansen and Jespersen 2013). Applying more transparent nudges might be an answer to these

criticisms, but since nudges sometimes work better in the dark (Bovens 2009), one can question the effectiveness of nudges if the underlying motives and mechanisms are revealed to the people. Purpose (or intended outcome), of course, is only one part of the intervention that nudged people are usually not aware of. The nudge itself, the underlying automatic processes, and the source are often unclear to those who are subjects of nudging (Marchiori et al. 2017). Interestingly, Hagman et al. (2015) found that people can find nudges acceptable and intrusive to freedom of choice in the same time.

Distinction between system 1 and system 2 nudges first was made by Hansen and Jespersen (2013) (sometimes also called as covert and overt nudges (Felsen et al. 2013). Both types of nudges target and benefit from automated modes of thinking, but system 2 nudges also involve reflective thinking. System 1 nudges include for example default rules, graphic warnings on cigarette boxes, or subliminal advertisements to discourage people from overeating or smoking, while system 2 nudges for example include factual information on packaging such as calorie labels, or public education campaigns adopted by national governments. System 2 nudges are usually considered to show greater respect for individual autonomy, and less manipulative than system 1 nudges Sunstein (2015). In this study we focused primarily on the public acceptance of system 1 nudges since the public support of system 2 nudges are less often questioned. Several studies confirmed that system 2 nudges generate higher level of public acceptance that system 1 nudges (Jung and Mellers 2016; Sunstein 2016). Acceptance of system 1 nudges may be larger when people favour their goals, and when they trust policy makers Sunstein (2016).

Although Loewenstein et al. (2015) showed that disclosing the purpose of a default setting does not modify the effectiveness of the choice architecture, its effect on public acceptance is still a question. Similarly, Kroese et al. (2016) found that disclosure about a system 1 nudge does not influence the effectiveness of the nudge. (In their study healthy food items were relocated to the cash register display, while unhealthy food were placed elsewhere in the shop). Yet, acceptance of the nudge was

not different across conditions (nudge, nudge+disclosure, and control), and 55% of the respondents thought that food repositioning and a sign indicating the nudge's purpose would be helpful to make healthier choices for them. In another study, however, Marchiori et al. (2017) doubt if people were really reading the sign in this particular experimental setting. Bruns et al. (2018) also argue that nudges can be transparent and yet effective. They used default values to boost contribution to a 'climate protection fund'. They saw a default-effect that remained when they revealed that default values may have an effect on their actual decision, and also remained when they disclosed the purpose of the nudge.

The main research question of this study is how public acceptance of system 1 nudges changes if people are more informed about the intervention, meaning that they know about the purpose and are aware of the competing policy alternatives. The other policy solution types are regulation, taxation, positive financial incentivization and providing information (can also be seen as overt nudges). Beyond this question we also wanted to explore how individual dispositions influenced the acceptance of subliminal nudges, and in the selected domains to what extent people favour system 1 and system 2 nudges.

For our analysis we selected prototypical nudges from 7 different domains: tobacco consumption, sustainable consumption, safe driving, retirement savings, organ donations, health checks, and sugar consumption. On these domains nudge policies are widespread all over the world, and are intensively documented and discussed in the literature. Many of them are related to health - which is one of the most popular fields of nudge interventions -, but we also picked examples from sustainability, transportation, and finances. Description of the nudges were taken from studies of Hagman et al. (2015), and of Jung and Mellers (2016), but were simplified in some cases.

3.2. Hypotheses

Few studies have been conducted on how goal disclosure influences the public acceptance of nudges so far. Nonetheless, lack of transparency is one of the major criticisms against nudges, therefore we hypothesized, if the goal behind the nudge is revealed to the people, it becomes more transparent, hence it may become more acceptable to the public. As Reisch and Sunstein (2016, p. 322) puts it: "If respondents believe that a nudge has legitimate goals,and that it fits with the interests and values of most people, they are likely to favor it." Marchiori et al. (2017) also see the potential value of making people aware of being nudged in increasing the acceptance of the policy intervention.

H 1. *Revealing the goal of the policy will increase the public support for the nudge.*

Hagmann et al. (2018) investigated the acceptance of 8 policy interventions to reduce sugar intake on a large Swiss sample. Policy interventions included negative financial incentive (sugar tax), enforced regulation (sugar reduction in products, substitution of sugar with artificial sweeteners), system 1 nudges (reducing availability of sugar-rich products, and reducing portion sizes), and system 2 nudges (sugar label, and public health campaigns). Researchers were able to compare public support of different interventions, but due to the survey design they were not able to observe whether revealing other policy interventions make system 1 nudges look more appealing or not.

Reynolds et al. (2018) demonstrated that support for nudges and taxes vary across domains (alcohol consumption, tobacco use, and high calorie snack consumption), but enforced regulation (ban the sales of products in certain shops) and taxation were usually the least preferred policy interventions compared with system 1 (reduction of serving size) and system 2 (labelling) nudges. Since some policy interventions were usually less popular than nudges (i.e. taxation and enforced regulations), we hypothesized that disclosure of policy alternatives, therefore raising awareness of less

favourable policy options to people, will make system 1 nudges more attractive to the subjects due to some contrast effect.

The study by Hagmann et al. (2019) already claims such an effect when nudges are compared to taxes. In their study support for carbon taxes dropped when a green nudge was also introduced, and so concluded that a nudge may crowd out support for taxes. The introduction of nudges can quickly turn counterproductive in these cases, when the support for more effective but more burdensome measures diminish with the introduction of a nudge. In our study we are interested in the opposite situations, where the application of a nudge may be a better fit than taxes or regulations, and see whether the support for them increase if the other policy alternatives are offered for consideration.

H 2. *Presenting other policy tools will increase nudge support.*

We expected one specific trait (reactance) to play a more polarising role to the different framings (revealing the purpose and the alternatives). In their study Jung and Mellers (2016) connected the trait psychological reactance to a decreased nudge support. Reactant people might have even more reduced support for a nudge, when they find out about the manipulation in the condition with revealed purpose. Similarly, we would expect their relative support to be higher when the more liberty encroaching alternatives (tax, mandate) are presented.

H 3. *Reactant individuals might show less support when the goal is revealed but warm to nudges when also seeing stricter policy alternatives.*

As we discussed earlier, system 2 nudges that are considered minimally intrusive are favoured by people according to the most studies conducted in this field (Reisch and Sunstein 2016; Jung and Mellers 2016). Other studies found that overt policies are supported to a greater extent than covert ones, but findings are somewhat domain specific (Felsen et al. 2013). Nonetheless, we hypothesized that this relationship will remain in the 7 selected domains present in our study as well.

H 4. *System 2 nudges are preferred over system 1 nudges, compared on the same domain and aim.*

3.3. Methods

We recruited 319 students studying business administration at a major Hungarian university for this study. Subjects completed an online survey in November 2018 using 'Qualtrics' software. We assessed people's opinion across seven different topics, where behaviorally informed policies are common (smoking, retirement saving, energy consumption, organ donation, speeding, screening examination, sugar consumption). Psychological reactance of the respondents was assessed with a range of 14 items adapting the scale developed by Hong and Faedda (1996)

In this study participants were allocated to three conditions. In condition 1 (N=117) participants rated system 1 nudges in seven different domains. In condition 2 (N=103) the purpose of the same system 1 nudges were revealed to the participants. In condition 3 (N=99) besides the purpose, four other competing policy alternatives (enforced regulation, negative incentive, positive incentive, and system 2 nudge) were presented to the subjects, and they were expected to rate all policy options. In the online questionnaire for attitude questions a 7-point-scale was used, in order to find out to what extent participants support policy alternatives and to what extent they think alternatives are effective. The answers on support: from not at all to fully support were coded as follows: -5, -3, -1, +1, +3, +5, and 0 as 'no opinion', to best reflect answer option layout (equidistance on the six opinionated items and the 'no opinion' further on the right).

3.4. Results

Under condition 1 when only policies were mentioned, support for system 1 nudges was the highest (Mean = 1.75, SD = 1.15 on the [-5, 5] coded scale). When the pur-

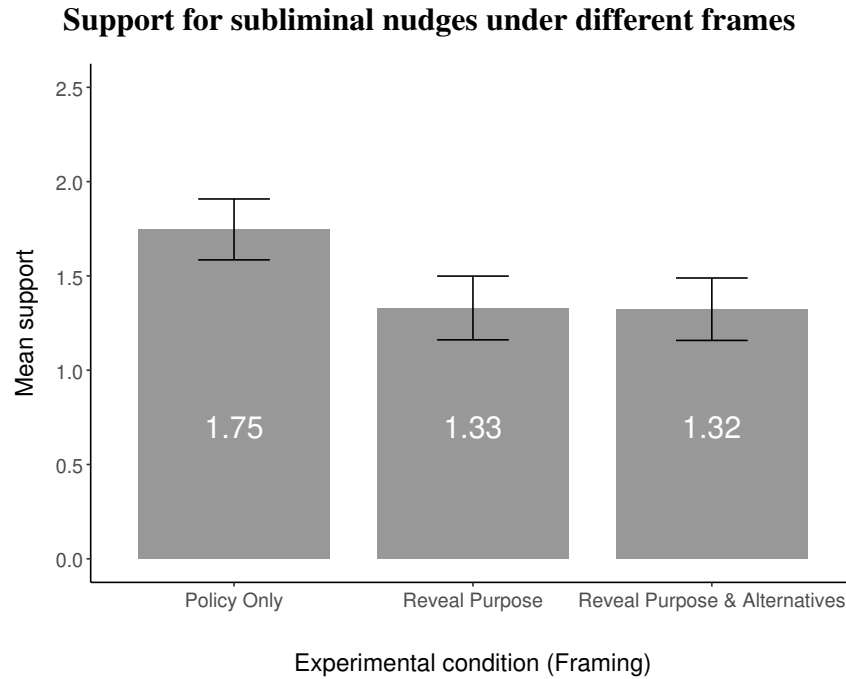**Support for subliminal nudges under different frames**

Figure 6.: The figure reports the mean support, across domains, for policies involving system 1 nudges under the experimental conditions. The range of options for support were coded between [-5 and 5]. Error bars represent 95 percent confidence intervals.

pose behind policies were revealed to the subjects, support dropped in condition 2 significantly (Mean = 1.33, SD = 1.01). These results suggest that revealing purpose does not increase the level of support of the nudge, on the contrary, it has a negative effect. H1 hypothesis is rejected, as we surprisingly find that support decreased with providing the purpose of the nudge. When competing policy alternatives (i.e. enforced regulation, positive and negative financial incentives, and an informative nudge) were also introduced in condition 3, support for system 1 nudges remained at the same level as it was under condition 2 (Mean = 1.323, SD = 0.99). This result indicates that more painful policy options such as taxes or stricter regulation did not make nudges more attractive to the respondents as it was expected. H2, hypothesis therefore could not be confirmed. We conducted ANOVA to demonstrate differences between conditions, which confirm the variances of the three groups all not all equal (F=5.41, df=2, p=0.0051), and as we can deduce, only in condition 1 is it significantly higher while in the other two conditions they are very similar. We share the support levels from each conditions on Figure 6

The reactance trait was not as strongly associated with nudge support as we hypothesized based on earlier studies. When we checked for the strength of correlation between the overall reactance index (a simple arithmetic mean of the individual items) and the level of subliminal nudge support (also taken as an index across domains), we have found no statistically significant association in either condition: (1) -0.057, p = 0.54; (2) -0.086, p = 0.39; (3) -0.138, p = 0.17. Consequently we can not affirm a difference in attitude for people with reactant traits and we reject H3.

Because the domain of policies is a relevant aspect to consider concerning the extent people support them, we also report the percentage of support in Table 2 and Table 3. On average, regulation and negative financial incentives are the least preferred policy alternatives, but large differences across domains suggest that one should be very cautious with these interpretations. For example, banning products with high sugar content is not supported by our subjects, but mandatory yearly health checks for employees are very popular in our sample. Great variations can be observed concerning negative financial incentives as well: while tax increase on tobacco products, for example, is fairly accepted, issuing a fine for those who do not attend yearly health checks are mostly rejected.

We found system 2 nudges to be widely supported regardless of policy domain. Therefore H4 hypothesis was accepted. Informatively acting overt nudges are the least intrusive policy alternatives, hence it was expected that they are the most supported amongst the five options in each domain. Our results demonstrate that system 1 nudges are more controversial than system 2 nudges in some specific domains. While opt-out organ donation system is not fully supported (which is exactly the case in Hungary), the use of road markings that encourage slow driving are extremely popular. It is fairly surprising that certain positive financial incentives were not supported by our respondents, but a reward for quitters who attend control health checks or a prize drawn among drivers who abide speed limit might have seemed too unrealistic for the Hungarian population. On average, positive financial incentives were in between regulation and nudges regarding their acceptance rates.

3.5. Discussion

The most common critique of nudges is that their manipulative nature and undercover influence on decision makers are not very ethical. Moreover, even if their application in the choice architecture results the desired effect, it does not foster the internalisation of norms, it doesn't bring along a mindset change among citizens. We hoped to demonstrate that two techniques, which can make the application of nudges more ethical and conscious, will also lead to a greater public support for them. We tested different frames to the questions around policy support by also including a description of the purpose, as well as encouraging broader views on a specific topic by introducing policy alternatives.

We focused on system 1 nudges since its true for them especially that they operate mostly in the dark, therefore they tend to be also less accepted. Yet, our findings suggest that this generally lower levels of support cannot be explained with people not being fully aware of the purpose of the policy makers, since raising awareness of that purpose even reduced the support for the nudges in our sample. These results are somewhat disheartening and do not help to step toward a more ethical practice and transparency around nudges. It also cautions policymakers on the application of nudge and calls for further research about properly applying and communicating behaviorally informed policies. Ways of implementing the ethical approach could be separating the decision environment and purpose communication, or only trying to apply nudges for cases where is wide consensus among members of the public.

People also keep their reservations about subliminal nudges when they learn what these policy interventions may be substituted with. Offering a variety of policy alternatives that work toward the same purpose did not effect the support for system 1 nudges in our study. While Hagmann et al. (2019) claim that introducing a nudge alongside a taxing alternative decrease support for the taxes, we could say that the reverse, introducing taxation alongside a nudge did not increase the support for the nudge. Importantly, we did not only include taxation but other alternatives as well,

which could have affected the results. The reason to include a wider variety of options was to asses the effect of painting a full picture. The more ethical avenue of nudge applications in public policy would require full spectrum of tools to involve in all discussions, and find the best fit for each domain. The importance of finding the proper match is further backed by the relatively large variance in support for specific policy types (except in the case of overt nudges) across the investigated domains. It seems the acceptability of a policy type is always dependent on the applied field. It also means that playing with a contrast effect, by proposing a stricter policies just to gather support for others, would generally not work.

Our findings suggest, that public support for nudges is greatly influenced by the domain where the nudge is introduced. For example, opt-out organ donation schemes were supported by only half of the participants while road markings that encourage slow driving was supported by more than 90% of our respondents. Notably, support for nudges in the same domain may even vary a lot, see for example the results of Reisch et al. (2017). It may question an assumption made by most studies dealing with public support of nudges, namely that support for domain-specific nudges can be simply aggregated. Future research should identify domains where nudges are more accepted and/or supported, and domains where other policies may work better such as negative or positive incentives or enforced regulations.

The presented study has important limitation regarding the composition of the sample, cultural context and the method of inquiring about policy support. Our respondents were young adults with a business education, who may understand economical concepts and societal welfare dilemmas better than a random member of the public, but they probably don't pay taxes yet (one of the policy alternatives) or have any interest in considering retirement savings or health checks at that age, which may have affected their answers. On the cultural aspect Reisch and Sunstein (2016) found that Hungarians approved health nudges (along with the Danes) to a smaller extent than other European citizens such as Italians, British, French and Germans, which can be relevant since several of the policies we inquired about were related to health (smok-

ing, organ donation, health checks, sugar consumption). Last, but not least, a note on assessing different types of policy alternatives. We have seen great variance across domains for the support of the same type of policy. It would be rational, that support for taxation is always higher than for a mandate, and positive financial incentives to be always preferred over negative ones. Although, we know people are not strictly rational, some of the results were surprising, especially the low support for positive incentives in case of quitting smoking and prizes for abiding speed limits. This indicates, that the determinants of policy support are very complex, and our study may not have identified them well enough on all domains to offer a fair comparison of policy types. It would be a great insight to policymakers and interesting area of further research to explore which factors are the most influential in determining support for public policies.

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Table 2: Support for different type of policies on the same domain - part 1/2

Domain	Policy Alternatives					Purpose
	Regulation	Fin.Incentive (Negative)	Fin.Incentive (Positive)	Nudge (System 1)	Nudge (System 2)	*given in conditions (2),(3)*
Tobacco Consumption	restrict places to purchase and to smoke	increase taxes on tobacco products	reward for quitters who attend health checks	deterring pictures placed on packaging	informative text about hazards on packaging	Because of health hazard, incentivize quitting
in favor	75%	76%	37%	64%	87%	
Sustainable Consumption	ban less efficient household products	increase taxes on less efficient household product	direct subsidies for efficient household products	restrict placement on prime areas of the shop floor	informative signs of energy efficiency on products	To protect the environment, incentivize buying energy efficient machines
in favor	67%	64%	97%	64%	95%	
Safe Driving	on-board computer limits speed in cars	increase fines for speeding	prizes drawn among drivers who abide the speed limit	use road markings that encourage slow driving	road sign for speeding compares time saving to accident	To prevent road accidents, incentivize abiding the speed limits
in favor	23%	63%	37%	92%	85%	
Retirement Savings	mandatory r. savings for employees	increase income taxes for those w/o r.savings account	tax returns based on r. savings account	default to have employee r. savings plan	inform new employees about benefits of r. savings	To prevent impoverishment in old age, incentivize having r. savings
in favor	62%	19%	94%	75%	91%	

Table 3: Support for different type of policies on the same domain - part 2/2

Domain	Policy Alternatives					Purpose
	Regulation	Fin.Incentive (Negative)	Fin.Incentive (Positive)	Nudge (System 1)	Nudge (System 2)	*given in conditions (2),(3)*
Organ Donation	mandatory entry to donor pool with social security	increase income taxes for those not in donor pool	one-time reward for entering donor pool	entering donor pool is default with social security	posters explaining the need for organ donors	In the interest of ppl in need of transplantation, incentivize entering the donor pool
in favor	33%	14%	73%	49%	93%	
Health Checks	mandatory yearly health checks for employees	issue a fine if not attending yearly health checks	attending health checks reduces social security fees	prompting ppl with emails and notifications to attend	posters explaining the benefits of regular health checks	Because early diagnoses improve recovery chances, incentivize health checks
in favor	94%	30%	86%	87%	95%	
Sugar Consumption	ban products with high sugar content	increase taxes for sugary products	decrease taxes for low sugar products	restrict placement of sugary products	package signs for sugar content of products	Because consuming too much sugar harms health, incentivize reducing
in favor	34%	65%	90%	82%	96%	

4. Study III. Nudging in the time of coronavirus? Comparing public support for soft and hard preventive measures, highlighting the role of risk perception and experience

Authors: Dudás Levente, Szántó Richárd

Abstract

The importance of researching public support for preventive policies have been amplified by the COVID-19 pandemic. Using a representative sample of the Hungarian population, we investigated the support for commonly used preventive measures (social distancing, hand hygiene and wearing masks) comparing two different policy tools (nudges and regulations). Because of the high risk and unfamiliarity of the pandemic, the respondents' risk perception and experience with the disease was also assessed. All preventive measures were generally supported and, contrary to the findings of previous nudge research, there was no clear pattern whether regulations or nudges are preferred. People with higher level of risk perception supported both types of policies more but slightly favoured the regulations. Those who had contact with the disease (either themselves or a close friend or family member contracting COVID-19) reported a higher level of risk perception. When the person themselves was afflicted,

this higher levels of risk perception did not translate to a higher level of support, moreover, it even decreased support for the regulations according to regression analysis. In case of a loved one contracting the disease, there was an increased support for both types of measures, but that is explained by the higher risk perception.

4.1. Introduction

Since the seminal book of Thaler and Sunstein (2008) policymakers have started to actively and consciously apply nudges. Nudges are defined as '... any aspect of the choice architecture that alters people's behavior in a predictable way without forbidding any options or significantly changing their economic incentives.' (Thaler and Sunstein 2008, p. 6). Numerous studies have investigated the effectiveness of nudges across a variety of domains, as summarized in the study of Szaszi et al. (2018), and it was specifically demonstrated that nudges can be effective in promoting healthy behavior (Li and Chapman 2013), environmentally conscious efforts (Schubert 2017), encouraging retirement savings (Benartzi and Thaler 2013), increasing customer satisfaction and firm's profitability (Goldstein et al. 2008), and in many other fields. The global pandemic presented a situation, however, in which the application of the libertarian-paternalistic approach needs to be re-evaluated.

Effectiveness of a behaviorally informed policy is not a guarantee to apply with success. The success of interventions concerning for example the combat against pandemics such as SARS, H1N1 or COVID-19 also depends heavily on the level of public support (Fu et al. 2020), because that support corresponds directly to the intent to comply with the policies (Franzen and Wöhner 2021). Public acceptance of nudges is a well-researched topic (Sunstein 2016*b*), and most studies revealed that the majority of people accept these types of interventions (see Sunstein et al. 2018, for a review). Several studies demonstrated that people prefer the softer approaches over restrictive measures or taxation (Diepeveen et al. 2013; Hagmann et al. 2018), and nudging has grown popular in recent years among policymakers, because of this relative popular-

ity. Another appeal of nudges is that the less intrusive approach makes them applicable where harsher measures are not tenable. However, the behaviorally informed policies are not only complementing the traditional tools, they also compete with them in a sense that policymakers can use these different approaches as alternatives (Quigley 2013).

The considerations about competing 'hard' and 'soft' approaches have received increasing attention by researchers and practitioners. Bans and mandates receive less support than behavioral interventions even when the outcomes of strong regulatory policies are more desirable to the people (Sunstein 2016a). Introducing these softer approaches can even be counterproductive. A study shows that support for carbon taxes drop when a green nudge is also introduced, and so a nudge may crowd out support for more effective, but more burdensome measures, like taxes (Hagmann et al. 2019). Still, Benartzi et al. (2017) suggest that the cost to impact ratio of nudges is better than their policy alternatives.

With more and more governments adding the libertarian-paternalistic approach into their policy toolbox (Sunstein et al. 2019) interest among researchers has increased to understand the underlying reasons for the support or rejection of nudges. One aspect of this understanding is how the quality of policies and the people themselves contribute to these decisions. Jung and Mellers (2016) had helped to understand a great deal about how individual dispositions, and perceptions of nudges contribute to the level of support for them, while Reynolds et al. (2018) showed that support depends heavily on perceived effectiveness as well as perceived fairness, personal beliefs, values of the individual, and demographic variables.

The importance of these topics in nudge research (the soft versus the hard approach, individual attitudes and perceptions) are further amplified by the highly pressing issue of the global pandemic that defined 2020. COVID-19 has also brought forth new challenges that needed answering from policymakers. What kind of preventive measures to implement has become an urgent question. Issuing strict restrictive regulations or

suggesting preventive behavior only through indicative nudges were competing alternatives.

In this paper we take a closer look at public support for these options using a survey instrument carried out when COVID-19 cases hit critical levels for the first time in the country, with respondents representative of the Hungarian population, and investigate three aspects that the pandemic gave new meaning to. Firstly, to what extent are the restrictive actions, regulations supported compared to the softer approach of behaviorally informed policies. Secondly, we examine how the perceived risk of the virus is influencing the support for the preventive measures, and whether it influences the preference between the nudges and regulations. Lastly, we take a look at how first-hand experience with the disease connects to risk perception and support for these policies.

4.2. Background

4.2.1. Types of nudges

The great appeal of nudges is that they preserve autonomy while significantly influencing behavior (Sunstein 2013). These characteristics of nudges can even be more welcomed when individual liberties are otherwise curbed. Previous research showed, however, that support for specific nudges can fall on a wide range, therefore we are reflective on the types of nudges we include in our study.

We can distinguish nudges based on the cognitive mechanism by which the nudges operate; system 1 & system 2 (Hansen and Jespersen 2013), which also relates to the transparency of this mechanism; overt and covert (Felsen et al. 2013). System 1 type nudges mostly influence automatic, heuristic decision-making processes, while system 2 nudges enable deliberative processing, and for this reason, they are generally seen as more acceptable (Jung and Mellers 2016). In the context of a pandemic, we have seen that the system 2 type nudging, which consists of educational and caution-

ary messaging, is usually applied together with other preventive measures to complement them. Therefore, we included system 1 type nudges into our study.

According to Hagman et al. (2015) there is a difference in acceptability of nudges regarding the beneficiary of the intervention. Pro-social nudges, which steer people toward socially beneficial behavior, even if it conflicts with maximizing private welfare, are less acceptable compared to pro-self nudges. In this regard, preventive nudges against the virus are all similar and, while they are both protecting the actor as well as their environment, they can be seen as pro-social acts. There is mounting evidence that nudges receive broad support everywhere in the world, especially in the domain of health (Reisch et al. 2017; Sunstein et al. 2018; Junghans et al. 2015), but the level of acceptance of nudges does vary across cultures (Sunstein et al. 2019), and even subcultures (Pe'er et al. 2019). In some countries (like in China or South Korea) they are accepted with enthusiasm (Sunstein et al. 2018), while in most western democracies people tend to provide them green light with some modest reservations, and there are countries (like Denmark or Hungary) where citizens are more cautious, and reluctant to support behaviorally informed policies (Reisch and Sunstein 2016). This latter is relevant for our study as it was conducted with Hungarian subjects.

4.2.2. *Preventive measures against COVID-19*

Behavioral change is a crucial factor to contain the spread of the COVID-19 disease. Previous findings of social science can help the creation of preventive policies, as it was outlined in the summary of Bavel et al. (2020). Policy makers should capitalize on the results of research about risk perception, science communication, aligning individual and collective interests amongst many other areas. Capraro et al. (2021) also provide insights on how to boost cooperation, which is essential during a pandemic.

Many of the large number of studies, that were published about the COVID-19 disease, concern the use of nudges and the majority of them endorse their application. Weijers and de Koning (2020) reported about a successful field experiment: with

different types of nudges (increasing attention and emphasizing the gains of hand sanitation) they were able to boost disinfectant use in Dutch shops. In another study, the authors report that local Chinese governments were able to increase the positive effect of two way risk communication on people's willingness to comply with COVID-19 policies by utilizing nudge interventions like descriptive social norms and infotainments (Guan et al. 2021). In a Japanese study nudged-based messages were sent to mobile devices to convince people to avoid crowded places and close contacts (Moriwaki et al. 2020). Through location tracking, mobility of the recipients was monitored and, under some conditions, these nudges were proved to be successful and cost effective. Prasetyo and Sofyan (2020) tested five visual campaigns to reduce travel intentions during the Eid festive season in Indonesia, and they found some of them effective in making people reconsider their plans to travel. Debnath and Bardhan (2020) consider the concept of nudging very broadly, and so they identify a great amount of nudges that were applied in 14 different policy sectors in India, which were concluded to have a measurable positive effect.

Some studies, however, have found mixed, or no results from the application of these behaviorally informed policies. An experimental research used social norms to steer people's behavior toward compliance with social distancing and lockdown measures, but they had mixed results about the effectiveness of this intervention (Hume et al. 2020). Blackman and Hoffmann (2021) did not find evidence that informational (system 2) nudges would boost intended compliance with COVID-19 regulations studying the attitudes of Colombian young adults, yet these nudges raised their level of concern about the disease. The right framing of cautionary messages is also a mechanism that can steer people toward compliance with preventive policies, but their effective application may be context dependent. In two studies with US participants Banker and Park (2020) found in the initial weeks of the COVID-19 outbreak that messages in social media framed 'protect yourself' or 'your loved ones' generated more interest than a pro-social frame ('protect your community'), while Capraro and Barcelo (2020) found some weeks later that the frame 'protect your community'

increased the intention to wear a face mask the most.

It seems essential for an effective pandemic defense, that the nudges are complimented with other approaches, and beyond these campaigns governments introduce "hard" rules as well. The use of solely nudge theory by the UK government at the early stage of the pandemic received strong criticism in March of 2020 due to the lack of drastic measures (Sibony 2020). The way to attain the necessary behavior changes can not only be achieved by nudges of course, but there are several other instruments like incentives, communication, bans, and mandates (Tummers 2019). In our research we compare the application of nudges with regulatory measures as these were by far the most used policies to combat the spread of the disease. When formulating the survey, we applied these policy interventions (regulations and system 1 type nudges) on the most frequently used infection control areas, namely: hand hygiene, social distancing, and mask wearing.

Although we agree with research cited in the Introduction that nudges are generally more well-received by the people than some stronger policy interventions, our study questions the universality of this claim. We argue that in some contexts stricter policies are more welcomed by the public. If people do not believe that certain soft policy measures can attain the necessary societal effect, they may prefer stronger regulations over nudges. Especially in high stakes situations where the effectiveness of policy interventions may result in fewer fatalities or lower incidence rates of a serious disease.

4.2.3. *Risk perception and policy support*

There is a wide consensus in the literature that risk perception influences policy support across various domains. Drews and Bergh (2016) claim for example that risk perception positively influences public support for climate policies; people who believe in immediate and severe negative consequences of climate change, respond to the policies in a reassuring way. Zahran et al. (2006) also found a robust effect of

subjective risk perception on climate policy support, while objective risk measures (like living close to coastal areas) explained only little variance of public support. In a totally different domain similar patterns can be observed: a perceived high risk of terrorism predicts preferences towards massive governmental spendings on counter-terrorism (Liu et al. 2019). Nevertheless, our knowledge on the risk perception–policy support relationship is still fairly limited, as (Gerber and Neeley 2005, p. 397) point out: 'relatively less attention has been devoted to explaining whether perceived risk systematically shapes an individual's views of public policies designed to manage possible hazards.'

The influence of risk perception on public acceptance of nudges in particular has been tested only in a few studies so far. Sunstein et al. (2019) did not find any significant relationship between risk perception and overall nudge approval. Risk perception in this study, however, was measured with one very general question. Bates et al. (2018) found positive relationship between the awareness of the link between alcohol consumption and cancer (i.e., awareness of the risk) and the public support of alcohol policies. The study did not investigate the approval of nudges specifically, but these types of interventions were included into the set of policies they looked at.

The unprecedented elevated risk, which the global pandemic has brought, emphasizes the re-evaluation of this psychological attribute and its relation to policy support. We can intuitively expect that higher risk perception corresponds with the backing of preventive measures. In our study we applied a set of COVID-19 related questions developed by Dryhurst et al. (2020) to assess the risk perception of our respondents and relate that to policy support.

4.2.4. *Personal experience with COVID-19*

Numerous studies have confirmed that personal experience is a principal predictor of risk perception. For example, personal experience with extreme weather events (heat waves, flood, etc.) increases the perceived risk of climate change (van der Linden

2014), women focused more on the risk of breast cancer after a diagnosis of a family member or close friend (Purnell et al. 2015), and direct exposure to the coronavirus increases the perceived risk of COVID-19 (Dryhurst et al. 2020). Nonetheless, the role of direct experience on public acceptance of behavioral interventions has been rarely investigated. Sunstein et al. (2019) found that drinkers did not support nudging in general, while smokers found government campaigns against smoking unacceptable. These direct activity-based rejections may not be expected in this current study, since the risks associated with the contraction of COVID-19 were surrounded with a great deal of uncertainty, and it affects not just the person but others as well.

Based on the relationship between first-hand experience and risk perception, we expect that first-hand experience with COVID-19 will elicit a greater level of approval of both regulatory and nudge policies. Those who experienced the consequences of the disease directly (because they were affected) or indirectly (through a family member or a close friend) may have higher risk perception and greater support for the preventive measures.

4.2.5. *COVID-19 situation at the time and place of data collection*

The survey was conducted in Hungary between the 16th and 20th November 2020, just after stricter regulations were put into place in the country because of daily new COVID-19 cases had increased to a critical level for the first time. We represent the strictness of containment measures based on Hale et al. (2021) represented over time by the line on Figure 7, along with the number of registered new cases over time represented by bars. The course of the first and second waves of the COVID-19 pandemic in Hungary was similar to other Central European countries, with some minor variations. In the first wave Hungary saw a small number of cases and fatalities compared to Western European countries, but the restrictions were nonetheless in place. In the second wave, starting 2020 autumn, incident rates and fatalities were higher. Up until the time of data collection regarding hand hygiene and social distancing there
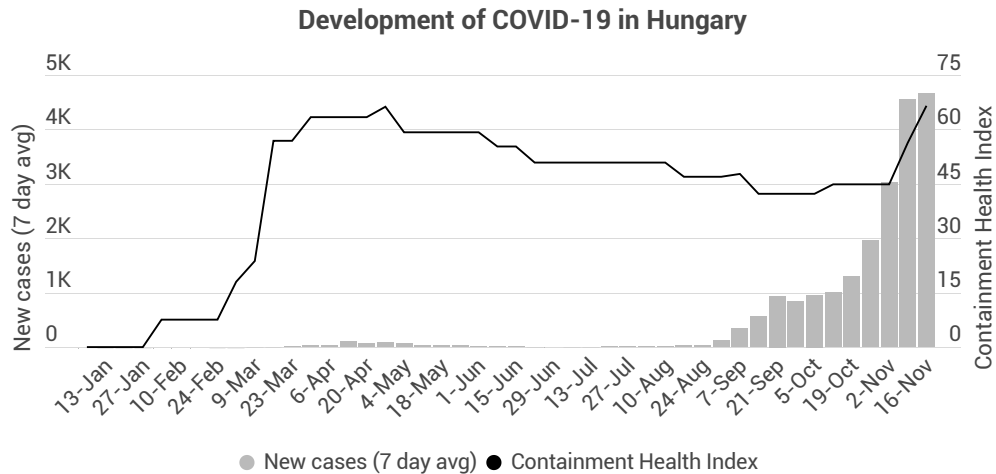
Figure 7.: New cases on a 7-day average and policy strictness measure (CHI) based on Hale et al. (2021)

were no mandates decreed, only nudges were applied, but policies for mask wearing went from strict to stricter, after mandating their use in public places indoors since the end of April, their use in public urban settings outdoors were also required starting mid-November.

4.3. Materials and Methods

4.3.1. Participants and procedure

One thousand Hungarian participants were recruited for this study. The demographic characteristics of the sample, in terms of our criteria for representative sampling, is presented in Table 4. An online survey design was applied, and the questionnaire was administered as part of a CAWI (Computer Assisted Web Interviewing) omnibus survey. The sample was representative of the adult Hungarian population under the age of 64 in terms of demographics (age, gender, education), with a slight possible bias of computer proficiency due to the CAWI nature of our survey. As is normal practice for qualitative sociological research, every effort has been made to preserve the anonymity of all interview participants. All participants provided informed con-

sent in a written format. The research has received the relevant ethics approval form the 'CUB Research Ethics Committee' of the university the authors are affiliated to.

Table 4: Composition of the sample

		% Sample
Age	18-24	12%
	25-34	20%
	35-44	25%
	45-54	22%
	55-64	21%
Sex	Female	50%
	Male	50%
Education	Primary	24%
	Secondary	56%
	Tertiary	20%

4.3.2. Measures

Risk perception was measured with a COVID-19 risk perception index that covers affective, cognitive, and temporal-spatial dimensions of risk perception based on Dryhurst et al. (2020). The construct contains six items: (1) level of worry, (2) perceived likelihood of direct personal effects, (3) perceived likelihood of direct effects on family members and friends, (4) personal beliefs about how many people in the country will be affected, (5) perceived probability of getting sick, and (6) getting sick seriously. In case of each item a 7-point scale was used (see Table 5 for exact items and scales). The index was calculated as a simple arithmetic mean of the individual items (α= 0.826).

Table 5: Survey items for risk perception index (Based on: Dryhurst et al. 2020)

Construct item	Scale
How worried are you personally about the coronavirus epidemic?	Seven point Likert scale, 1 = not at all worried, 7 = very worried
What do you think about the following statement? The coronavirus will NOT affect very many people in Hungary.	Reverse coded, Seven point Likert scale, 7 = strongly disagree, 1 = strongly agree
What do you think about the following statement? Getting sick with the coronavirus can be serious.	Seven point Likert scale, 1 = strongly disagree, 7 = strongly agree
How likely do you think it is that your family members or close friends in Hungary will catch the coronavirus in the next 6 months?	Seven point Likert scale, 1= not at all likely, 7 = very likely
How likely do you think it is that you will catch the coronavirus in the next 6 months (if you had it already, you will catch for the second time)?	Seven point Likert scale, 1= not at all likely, 7 = very likely
What do you think about the following statement? I will probably get sick with the coronavirus in the next 6 months.	Seven point Likert scale, 1 = strongly disagree, 7 = strongly agree

Table 6 presents three hard and three soft policy measures that participants had to rate, to what extent they supported them. Responses were given in a seven point scale ranging from 1 (certainly oppose) to 7 (certainly support). The policies we call softer, can be categorized as system 1 nudges, while the harder policies, are strict mandates also called regulations. For further analysis, focusing on the difference in attitude toward the two types of policies, we calculated a nudge support and a regulation support index as the average of corresponding survey items (Cronbach's alpha for regulation

Table 6: The wording of the 3 hard and 3 soft policy measures.

Preventive Measure	Regulation (hard approach)	Nudge (soft approach)
Hand hygiene	People are not allowed to enter public places without disinfecting hands at the entrance	At the entrance of public places painted footprints on the floor lead to sanitizers with colorful instructions
Social distancing	People are not allowed to enter public places until the number of people is below a limit when the 1.5-meter distance can be guaranteed	In public places stickers on the floor show 1.5-meter distance, to notify about the importance of social distancing
Wearing mask	People are not allowed to enter public places without wearing mask hiding their nose and mouth	At the entrance of public places posters highlight that 9 out of 10 people wear mask to combat with the pandemic

support $\alpha = 0.859$, nudge support $\alpha = 0.862$), and also constructed a variable measuring the difference in support between regulations and nudges for each of the three prevention areas ($\alpha = 0.2$). When these difference variables have positive values, the regulatory intervention was rated higher than the corresponding nudge policy.

The respondents' experience with COVID-19 was also assessed in the survey. For the purposes of this study, direct experience means the participant contracted or thought they contracted COVID-19, whereas indirect experience means a family member or close friend had contracted it. When testing direct experience respondents had to answer whether they had COVID-19 or not. We also included an option for stating that the respondent thought that he or she was infected with coronavirus but was not tested. Those who actually had a positive COVID-19 test and those who thought

to have had the disease were coded as one group. Surveying indirect experience, the following question was presented to the participants: "To the best of your knowledge, was anyone in your direct environment (family members, close friends) infected with the coronavirus?" (dichotomous, yes or no scale).

4.3.3. Statistical analysis

For our first research question, how the support for nudges and regulations compare in an increasingly risky environment, we evaluate the responses for policy support in two different ways. From one angle, we are interested in the ratio of those who supported the policies (given answers on the positive side of the scale) compared to those who did not (neutral or negative). We test the association between this dichotomized support and the policy types for each prevention area separately using contingency table based χ^2 tests. We also evaluate the support for policies looking at the original distribution of responses given on the seven point Likert scale. Normality of distribution is not confirmed by Shapiro-Wilk tests for the six policy support variables, regulations and nudges assessed on the three prevention areas, therefore we test the difference in support using nonparametric Wilcoxon–Mann–Whitney tests.

Next, we aim to investigate the association between risk perception and policy support, with particular focus on differences regarding the policy types. We are interested to see, if there is a shift in preference in terms of policy strictness among people with higher levels of risk perception. To test this, we calculate Pearson correlation coefficients between the risk perception index and the policy support measures employing the constructed indicies for risk perception, nudge support and regulation support, as well as the difference in support variables. The low Cronbach alpha value (0.2) for the difference in support indicates contrasting relations across the preventive areas we investigated, therefore we calculate the correlation of risk perception and the support variables for the three areas separately as well.

The last aspect of the research concerns the respondents' experience with COVID-

19, and how that affects the individuals risk perception, or preference in policy strictness. We defined the experience as it can occur directly (contracting the disease) or indirectly (a close friend or family contracting it). The occurrence of the two experiences can obviously be related and, consequently, examining their cross relation should not be neglected. We take the Cartesian product of the two binary, experience variables and evaluate the mean risk perception, support for regulations and support for nudges across the four groups using the constructed indicies. Since the aggregated indicies were also not found to be normally distributed based on Shapiro-Wilk tests, we use the nonparametric Kruskal–Wallis test for one-way analysis of variance to determine differences in distribution among the groups defined by experience, and complement it with pairwise analysis using Mann–Whitney tests with Bonferroni correction to correct for multiple comparisons when calculating significance. This provides us with an understanding of the association between the experience with the disease and the other main variables separately, but to be able to focus more intently on the interaction of experience and risk perception, and how they can correspond to support for the policies, we also fit a regression model. Nudge support index and the regulation support index are defined as dependent variables in the OLS regression models, and risk perception index, the experience variables (examining models including just one or both together), and the interaction terms between risk and experience are included as independent variables. Besides measuring the extent these variables can predict support for the policies, when we interpret the results, we will also be interested in the differences in model composition for the two types of policies.

4.4. Results and Discussion

4.4.1. Preventive measures

Our results reveal, that public policy measures were generally supported, but there is no clear pattern to whether hard or soft policy measures are preferred across the preventive strategies we looked at. Our takeaway from this is that in situations when
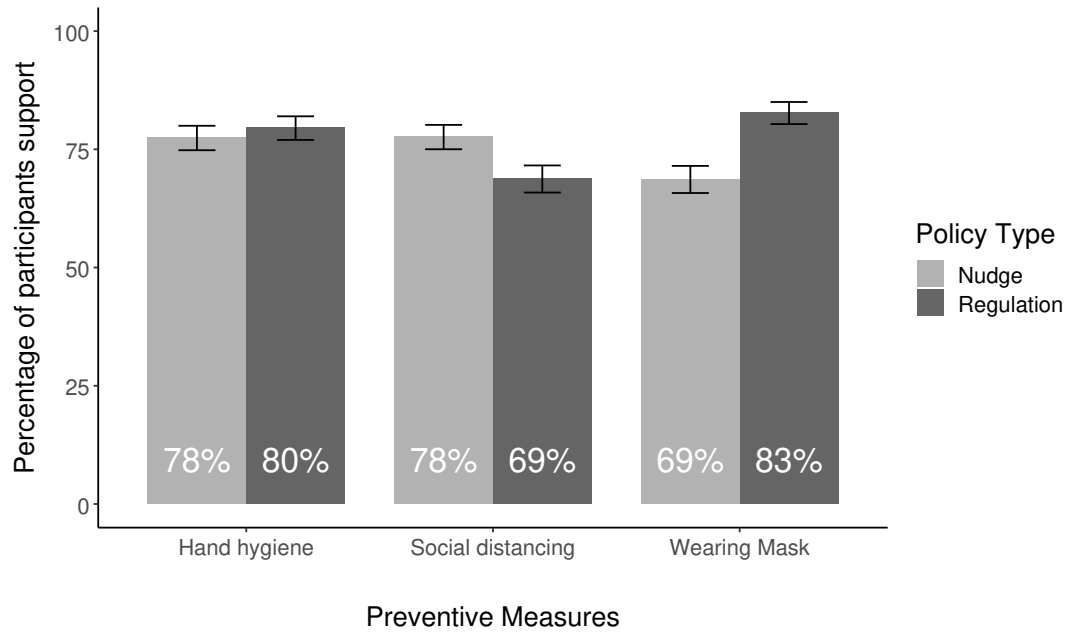
Figure 8.: The figure reports the percentage of respondents whose support was on the positive side of the scale (from 'rather support' to 'certainly support'), the midpoint (neutral) not included. Error bars represent 95 percent confidence intervals.

the associated risk is high, in contrast to more ordinary settings, hard policy measures receive the same or higher approval ratings than nudge applications. Figure 8 reflects what percentage of respondents supported the policies, and in Table 7 we also report the mean support for them. The differences in support for the two types of policies are analogous when we evaluate them using the means or percentages. In case of hand hygiene there is no significant difference between the two types of measures ($\chi^2 = 1.187$, p = 0.276). Respondents viewed nudge intervention more acceptable regarding social distancing ($\chi^2 = 19.761$, p < 0.001), while the regulation prescribing wearing mask was rated higher than nudging ($\chi^2 = 53.35$, p < 0.001). When interpreting these results, one should consider that wearing masks was an exceptionally hot topic in Hungary at the time of the data collection. The Hungarian government tightened the rules for mask wearing shortly beforehand. The recently introduced stronger policies might also have increased the approval ratings of mask wearing policies.

Some cross-country studies stated that in Hungary (along with Denmark and Japan) people are very reluctant to accept nudge policies (Sunstein et al. 2019). Our results

suggest a more nuanced view about countries that are not nudge enthusiasts according to these studies. All three nudges we investigated received fairly high approval ratings in the Hungarian context, meaning when people's risk perception is high, they may approve nudges that reduce risk whatever their preferences regarding nudges in general. Hence, public support of behavioral intervention policies is domain specific and context dependent. This finding is supported by other studies too. Jung and Mellers (2016) mention that despite the general public approval of nudges in the US, some interventions were still opposed. Meanwhile, mandatory subliminal advertising to discourage smoking and overeating was widely rejected in the study of Reisch and Sunstein (2016) even in countries with generally high nudge support.

Table 7: Mean support for preventive measures.

	Regulations		Nudges	
	Mean Support	*St.Dev.*	*Mean Support*	*St.Dev.*
Hand hygiene	5.21	1.64	5.62	1.37
Social distancing	5.6	1.51	5.59	1.39
Wearing mask	5.9	1.52	5.37	1.59

Note. The table reports summary statistics of policy support assessed on a seven point Likert scale coded 1 through 7.

4.4.2. *The influence of risk perception on policy support*

The level of support for policies in our sample is demonstrated above, and before sharing results about its association with risk perception, we report descriptive statistics about the risk factors of coronavirus. As the means in Table 8 indicate, the perceived risk of our respondents was fairly high, with the virus affecting many people and the sickness being serious the most agreed upon components of this assessment.

We hypothesized that those with high risk perception would favor regulations and,

Table 8: Descriptive statistics on risk perception

	Mean	St.Dev.
Risk perception index (aggregate)	4.77	1.11
Worried about	4.65	1.63
Affect many	5.54	1.49
Sickness is serious	5.57	1.32
Likely in family	4.86	1.59
Likely to contract	4.13	1.56
Likely get sick	3.89	1.54

Note. The table reports summary statistics of risk perception about COVID-19 assessed on a seven point Likert scale coded 1 through 7.

among them especially, the advantage of the softer approach showed in other studies would diminish. Table 9 presents that there is a moderate correlation between the risk perception index and the approval of both regulatory and nudge interventions. This level of correlation is similar across all prevention areas. Moreover, there is a relatively weak, but significant positive correlation between the risk perception index and the difference variables, meaning that people with a higher level of risk perception favor regulatory approaches slightly even more. We mentioned that recent policy changes could have influenced responses about mask wearing, and given that the individual respondents' difference in policy support correlated more strongly with risk perception in case of mask wearing, these changes may have also polarised the responses. We reason, that those who did not think the more strict regulations are necessary, or did not intend to comply, showed more support for nudges.

Table 9: Correlations between risk perception and policy support

	Mean Support		Hand Hygiene		Social Distancing		Wearing Mask	
	r	p	r	p	r	p	r	p
Risk Perception - Support Regulation	0.55	< .001	0.46	< .001	0.45	< .001	0.55	< .001
Risk Perception - Support Nudge	0.50	< .001	0.45	< .001	0.46	< .001	0.42	< .001
Risk Perception - Difference in Support			0.07	.02	0.10	.0012	0.13	< .001

Note. The table reports correlations (Pearson's r) and significance (using Bonferroni adjustment) between risk perception and the different preventive policies. The 'mean support' and 'difference in support' are calculated variables.

Based on our findings, risk factors considered to be exceptionally harmful and threatening by the public may push citizens towards the direction of accepting stronger regulations. This result explains – at least to a certain extent – why many people in British and Dutch societies were shocked and skeptical with the approach their government represented in the early days of the coronavirus crisis (Sibony 2020). People's risk perception index was one of the highest in the UK in the Spring of 2020 according to a comparative study (Dryhurst et al. 2020), consequently they would have expected stronger measures. Solely using nudge interventions seemed insufficient to them when considering the risk they perceived. Earlier studies confirmed that bans, mandates, taxes, etc. were less popular than nudges (Diepeveen et al. 2013; Hagmann et al. 2018; Sunstein 2016b), but our results suggest that when the perceived risk is high, governments should not rely exclusively on nudge interventions if they want to gain support and compliance from their citizens.

4.4.3. *Experience with COVID-19*

A very small number of our respondents (2.5%) tested positive for COVID-19 prior to the data collection, which was approximately equal to what official statistics reported at that time. However a bigger group, an additional 13.7% of the respondents were convinced that they had been infected with the virus, but they did not have themselves tested. This seems exaggerated, but somewhat believable due to the very high ratio of positive tests during the second wave in Hungary (climbing over 20% in 2020 November) suggesting a much higher infection rate than the official number. To evaluate the direct experience we coded both the tested and untested groups as 'Yes'. About the indirect experience, 34.6% of our sample asserted that their family members and/or close friends were affected by the disease.

We tested how the combination of these experiences are associated with risk perception and policy support and report the results in Table 10. The Kurskal Wallis tests indicate that at least one of these groups stochastically dominates one other group regarding risk perception, (χ^2 = 85.5, df = 3, p < .001) regulation support (χ^2 = 13.1, df = 3, p = .004) and nudge support (χ^2 = 11.2, df = 3, p = .011). The pairwise comparisons show significant differences in cases where the difference in mean ranks are larger: the 'no experience' group differs from all the others regarding risk perception, and the 'indirect experience only' group differs from the 'direct experience only' group in terms of policy support (both nudge and regulation). The latter suggests that direct experience may decrease, while indirect experience may increase the support for the policies.

To investigate the role of experience further, and test to what degree are variations in policy support explained by experiences with COVID-19, risk perception and their effect on each other, we evaluated linear regression models and report the results in Table 11). In four simple models to explain the support for policies [M1 - M4] we included the risk perception index (RPI) and either one of the experience variables as well as their interaction with the respondent's RPI. The coefficient of the risk percep-

Table 10: Cross relation of direct and indirect experience

Experience	N	Risk Perception		Support for Regulations		Support for Nudges	
		Mean	Mean Rank	Mean	Mean Rank	Mean	Mean Rank
No experience	595	4.51	431	5.50	489	5.49	494
Indirect experience only	243	5.16	603	5.81	546	5.70	535
Direct experience only	59	4.98	566	5.16	412	5.10	401
Both direct and indirect	103	5.23	620	5.64	512	5.58	513

tion is strong and significant in all of these models.

Models [M1] & [M2] show that the direct experience does have a negative effect on policy support, which is significant in case of regulations and, also marginally significant for nudges. In models [M3] & [M4] we see that indirect experience does not have a significant main effect alongside the risk perception for either policies. This suggests that any affect on policy support from the indirect experience is fully explained by the higher risk perception fueled by that experience and the social amplification of risk (Kasperson et al. 1988). If we include both types of experiences in the models [M5] & [M6], we see that only the coefficient for the RPI is significant for the mean nudge support and, in case of regulations, direct experience also significantly contributes to support, decreasing it. The interaction effects are not significant in models [M1 - M6], meaning that there is no evidence that the effect of risk perception on policy support is conditional on the subjects' experience.

Somewhat surprisingly, there seem to be two contradicting effects on policy support for people who already contracted the disease. While the experience's contribution to a higher risk perception should increase the level of support, there is also a tendency to

support the preventive measures less. One should note that people who had COVID-19 are believed to develop protective antibodies. They could become immune against the virus in the short run (Altmann et al. 2020), so these subjects may not personally rate interventions as critical. On the other hand, if a family member or a close friend is infected with the virus, the level of risk perception increases without this feeling of protection. It can explain why indirect experience triggers higher level of approval of the interventions connected to the higher risk perception, while direct experience does not.

4.5. Conclusion

In the last decades the use of nudges has become an essential part of the public policy toolbox in many countries of the world. Therefore, it was no surprise that they were also applied in the combat against the COVID-19 pandemic. Governments started to experiment with different forms of nudges to reach compliance with some non-pharmaceutical interventions such as mask wearing, hand hygiene, and social distancing. Various studies have reported about the high level of public support and the effectiveness of these nudges, but at the same time, some interventions proved to be less successful. This study looked at how risk perception and experience with COVID-19 influenced the approval of these policy interventions, and surfaces some practical implications for policy makers conducting risk communication campaigns.

The results of our study indicate that we should advise against the sole use of nudges in a pandemic that has brought unprecedented risks to most societies, since they suggest that the presence of high risk increases the public's preference for stricter regulations. If governments underplay the seriousness of the pandemic, which would therefore make people perceive the level of risk lower, that would undermine the public acceptance of any policy measure. For this reason, politicians are in a delicate situation: they want to demonstrate their competencies and the effectiveness of the measures they implement, and they do not want to spark unnecessary panic. If the

level of risk perception drops because of such a narrative, then citizens would not welcome the interventions needed. In contrast, a risk that is considered high, enhances the legitimacy of the introduced measures.

Since direct experience negatively influences policy support, policy makers should pay special attention to those who had already contracted COVID-19. They may diminish the public support of the preventive measures because of their selfish desire to get back more freedom, stemming from a feeling of immunity, or by spreading a message that the disease does not cause big trauma. As a pandemic develops, more and more people get infected, hence these interventions could be less and less supported because of this effect. Therefore, in their risk communication, authorities ought to emphasize the protection of family members, friends, and vulnerable members of society by complying with preventive measures, instead of underlining the inherent dangers of catching the virus.

Our study has some important limitations. The COVID-19 situation in all countries has been very dynamic, policies have often been introduced in short notice. These rapid changes influence significantly what respondents think about restrictions, mandates, information campaigns, and nudges. Due to the CAWI survey instrument that was used in this study, only people below the age of 64 were included into the sample, which excluded the most vulnerable portion of the population. The survey responses may also be slightly biased in absolute terms, since the items and question blocks were not randomised. An ordering effect may have increased support for policies because risk related questions were asked beforehand, and could have had an effect on the individual items as respondents can be expected to take the first item as a reference point. As the focus of our research questions was on relative differences between policy types and risk perception, not accounting for survey order effect should not weaken the findings. COVID-19 related topics have been heavily politicized in Hungary, therefore survey responses may, to some degree, depend on political preferences that were not investigated in the current study. People may embrace or reject nudge policies based on so-called partisan cues (Tannenbaum et al. 2017); hence the role of

preferences should be analyzed in future research.

Supporting Information

Figures:

- S1 Development of COVID-19 in Hungary.

    The figure reports the course of the pandemic capturing two measures. The containment health index based on the data from Hale et al. (2021) showing the strictness of policy measures and the number of daily new confirmed cases based on WHO data, smoothed with a seven day moving average.

- S2 Policy support of the preventive measures.

    The figure reports the percentage of respondents whose support was on the positive side of the scale (from 'rather support' to 'certainly support'), the midpoint (neutral) not included. Error bars represent 95 percent confidence intervals.

Further supporting data are also publicly available on the Open Science Framework (OSF) website: https://osf.io/4637w/. The repository contains: full survey questionnaire, raw survey data, list of variables (codebook) and scripts of the analysis (R code). DOI: 10.17605/OSF.IO/4637W

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nerability and Policy Support', *Society & Natural Resources* **19**(9), 771–789. doi: 10.1080/08941920600835528.

Table 11: Regression models on policy support

	Support Nudge [M1]	Support Regulation [M2]	Support Nudge [M3]	Support Regulation [M4]	Support Nudge [M5]	Support Regulation [M6]
Risk Perception	0.629 ***	0.761 ***	0.606 ***	0.707 ***	0.64 ***	0.767 ***
	(0.048)	(0.05)	(0.036)	(0.038)	(0.049)	(0.051)
Direct Experience	-0.826 .	-1.229 *			-0.748	-1.176 *
	(0.498)	(0.515)			(0.512)	(0.53)
RP x DE	0.082	0.157			0.072	0.149
	(0.096)	(0.099)			(0.099)	(0.102)
Indirect Experience			-0.355	-0.373	-0.195	-0.138
			(0.372)	(0.386)	(0.38)	(0.393)
RP x IE			0.037	0.047	0.02	0.016
			(0.073)	(0.075)	(0.074)	(0.077)
Constant	2.372 ***	1.765 ***	2.602 ***	2.164 ***	2.317 ***	1.73 ***
	(0.249)	(0.258)	(0.186)	(0.193)	(0.256)	(0.265)
F statistic	120.21	154.48	113.96	145.76	72.4	92.65
	(3, 996)	(3, 996)	(3, 996)	(3, 996)	(5, 994)	(5, 994)
Prob > F	< .001	< .001	< .001	< .001	< .001	< .001
Adj. R^2	0.264	0.315	0.253	0.303	0.263	0.314

Note: The table reports the estimates of linear models where the outcome variable is the mean support for nudges or regulations. Standard errors are in brackets for the input variables. The categorical experience variables were specified to be a contrast centered at 0. They have the value 1 in case of an experience and -1 in absence of it. RP abbreviates the risk perception index, DE the direct experience, IE the indirect experience. The interaction terms are denoted using (x). Significance levels are denoted with (.) when $p < 0.10$; (*) when $p < 0.05$; (**) when $p < 0.01$; (***) when $p < 0.001$.

5. Study IV. What influences the support for anti-epidemic measures?

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Translated from the original Hungarian by the doctoral candidate. The English version completely matches the content of the original

Abstract

Public reactions to the COVID pandemic range from extreme fear to the negligence of risk messages; one possible explanation for this is the skepticism about risk factors or preventive strategies. The relationship between support for prevention measures and epidemic-related skepticism or other potential explanatory variables (trust, worldview, experience with the disease) was examined in a sample of undergraduate and graduate students. In the study, the direct impact of the skeptical statements on policy support is tested. The authors focus on the antecedents of policy support and their relationship with skepticism using a structural equation model. Their path analysis confirms that skepticism is a strong predictor of support for preventive measures and also plays a mediating role between policy support and its antecedents. The order of questionnaire items is influential, i.e., those who first saw the skeptical arguments

reported slightly lower support for prevention policies. Prosocial values, the credibility of scientists and, surprisingly, a lack of trust in others can help increase support for policies. Contrary to the authors' assumption, trust in others shows a negative correlation with support for policies, suggesting that when people do not trust others, they require stricter regulations to increase their own safety.

Introduction

The COVID-19 pandemic has drawn the attention of several researchers working in the field of risk assessment. Certain societies have faced/continue to face never-before-seen risks in the spread of the pandemic (Rubaltelli et al. 2020), which provoked (and continues to provoke) highly diverse and often extreme reactions in the population. The media worldwide reports daily on the continuously evolving data on infection and fatality rates, as well as on the drastic or less severe packages of measures that have been introduced to curb the spread of the disease.

The population's responses to the pandemic run the gamut from fear through downplaying the risks of contracting the disease (Koon et al. 2021) to denying the existence of the virus itself. In many cases, individuals engaging in such responses will even trivialize the risks of contracting the disease and a more severe course of infection (Hakim et al. 2021). Thus, the question arises: how is it possible to have encountered such extreme attitudes towards the coronavirus epidemic? What is more, people's reactions continue to evolve with the progression of the pandemic (Bazzi et al. 2021; Jørgensen et al. 2021); many of those who, at the outbreak of the pandemic had been afraid of contracting the disease, went on to downplay the risks in a few months' time, or even outright denied the existence of the virus, and certain segments of society were overcame with resignation or carelessness. Therefore, doubts about the course of the COVID-19 viral infection and the potential severity of the disease can be encountered every day, social media platforms abound in such messages. Latkin et al. (2021, 1. o.) defines COVID skepticism as "an attitude that denies the severity of the disease and

claims that the pandemic is fake news,". According to Krimsky (2007), open internet platforms contribute to the intensification of the phenomenon, since expert opinions are merely secondary sources in online communities. In their study, Lewandowsky and Oberauer (2016) argue that we can "encounter similarly risk-skeptical voices" on topics ranging from smoking, through the climate crisis, to the coronavirus pandemic.

Researching this topic, which is the focus of our current study, is particularly important because people's susceptibility to skepticism will greatly influence the effectiveness of governmental measures introduced against the coronavirus pandemic. COVID deniers will also have a different attitude to those preventative measures which serve to prevent and slow the spread of the disease. Our research predominantly examines this relationship, that is, we have studied how doubts about the existence/dangerousness of the coronavirus influence the social acceptance of preventative measures introduced against COVID-19, and what are some of the factors behind this attitude. In the course of our research, we asked young adults to what extent they agree with statements questioning the existence of the coronavirus and to what extent they support the three measures listed in the survey questionnaire (mask mandates, hand sanitizing, and social distancing mandates). The reactions of young adults are interesting because the accessible information (messaging) was vastly different in the first wave (Spring 2020) and the second wave (Fall-Winter 2020) of the pandemic. While during the first wave most information focused on protecting the elderly, information published during the second wave emphasized that not only the elderly, but young people are also exposed to infection and, as a result, they are hospitalized and die at vastly higher rates than during the first wave. Young adults' susceptibility to COVID-skeptical messages was likely increased by this mixed messaging.

5.1. Research background

5.1.1. Factors affecting the social acceptance of governmental measures

Trust in social actors and institutions affects the social support for certain (governmental) measures and their potential rejection. In their study, Devine et al. (2021, p. 282) put it as follows: "trust is going to be key in the outcome of the current [coronavirus] crisis." Several authors have pointed out that trust has a crucial role in the evolution of commitment to different governmental measures. According to two studies carried out in Sweden (Harring 2018; Hammar and Jagers 2006), faith in public administration is closely connected to the acceptance of environmental measures, while support for a carbon-monoxide tax is linked to trust in politicians. Those who believe that the government can fight terrorism will be more accepting towards related national expenses (Liu et al. 2019). A comparative study surveying twelve countries has highlighted that the recognition of the work of scientists is an important drive behind the population's agreement with anti-COVID measures and compliance with regulations introduced to combat the pandemic (Algan et al. 2021). The same study also points out that if messaging by the government and messaging by the scientific community are not in sync, increasing trust in the government will coincide with decreasing acceptance of epidemiological measures, as a high level of trust in others will, paradoxically, adversely affect the support for central measures.

Jørgensen et al. (2021) have examined, in a large-scale sample survey (N = 124,062), which political factors influence the support for measures against the coronavirus epidemic in eight western democracies. Researchers have found that political affiliation is an important indicator of commitment to the measures. That is, those who voted for the governing political powers in the last elections tended to agree more with epidemiological measures than those belonging to the opposition. Information about the coronavirus and such factors indicating a stance of solidarity, like interpersonal trust and friendship, also show a positive correlation with the acceptance of measures. This finding is supported by the results of an analysis carried out in May 2020 in

Switzerland, which suggests that a higher level of social solidarity predicts a higher level of agreement among young adults (Franzen and Wöhner 2021).

Brzezinski et al. (2020) analyzed mobile phone cell data and found that United States counties with a lower rate of climate skeptics in the population will present a higher rate of compliance with regulations regarding COVID-19 closures. These findings suggest that skepticism about climate change or about science in general can influence the acceptance of measures regarding the coronavirus pandemic and compliant behavior therewith. Bazzi et al. (2021) claim that it is "raw" individualism in the United States that can be seen as one of the principal movers of distrust in science, which, among other things, is also responsible for some of the governmental responses to the COVID-19 pandemic. According to Clarke et al. (2021), certain ideological convictions, such as conventionalism, dominance, and anti-equalitarianism negatively affect the social support for restrictions. Campbell and Kay (2014) measured the effects of skepticism on public policy. Their results suggest that there is a close correlation between skepticism and people's worldview, and it is also highly polarized along political fault lines when debates about measures are a part of current political discourse.

5.1.2. *Virus skepticism, denial, relativizing*

The theory of risk denial was developed by Peretti-Watel (2003), who used the neutralization theory of Sykes and Matza (1957) as his foundation. While the original concept includes such neutralization techniques that criminals used to justify their deeds, Peretti-Watel identified risk denial forms (scapegoating, self-confidence, and comparing different kinds of risk) exhibited by young adults using soft drugs. According to Peretti-Watel et al. (2007), those individuals who engage in activities such as smoking or excessive alcohol consumption, which are seen as harmful by society, will not only be mistaken in identifying the risks inherent in these activities but they will also deny their risky nature.

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Besides risk denial, Bocquier et al. (2017) also use the term risk relativization. They understand the latter to mean the comparison of a given risk factor and a similar, already accepted risk. When examining the perception of cancer connected to alcohol consumption, they have found evidence of higher rates of risk denial and risk relativization among men and older generations, and the exceeding scale of risk relativization also predicted a higher level of daily alcohol consumption. Guastafierro et al. (2021) have also found that in the early stages of the coronavirus pandemic, when the number of cases was still relatively low, the elderly perceived the health risks caused by COVID-19 as lower than those of the common flu, as opposed to the perceptions during the second and third waves.

Furthermore, Hakim et al. (2021) use the term disease denial in connection with the coronavirus pandemic. According to their findings, disease deniers do not believe in the existence of the coronavirus at all, or they rationalize the negative effects of the epidemic; however, when they want to minimize the significance of the pandemic, they use different arguments than those presented in the discussion of risk denial theories (Peretti-Watel 2003; Bocquier et al. 2017). For instance, COVID skeptics will frequently claim that official statistics make no sense or they present an outright false image. They do not believe in the effectiveness of preventative measures either (such as wearing a mask, hand sanitizing, or social distancing), and they deem the negative economic consequences of such measures to be more notable than the social use thereof. COVID skepticism has introduced a new quality into the research of risk skepticism.

5.1.3. *Potential explanations of skepticism*

Needleman (1987) already noted in the 1980s that researchers tend to pay more attention to extreme reactions given to information about risks than to cases in which the population underestimates the severity of the consequences. As the author notes: "people are subject to the influences and limitations of their social environments;

from time to time they re-evaluate their decisions about risks; and they may react to risky information with denial, cynicism or fatalism" (Needleman 1987, 22. o.). From a psychological standpoint, skepticism about risks can be explained by, among other things, excessive optimism. Those who "have fallen into the trap" of optimism believe that they are less subjected to negative effects than their peers (Weinstein 1989). In the course of their research, Costa-Font et al. (2009) have found evidence of excessive optimism in the face of unknown risks, and a recent study conducted on a sample in the United States has found that excessively optimistic people perceive the risks of the coronavirus to be lower (Park et al. 2021). As certain results presented in the literature indicate that unrealistic optimism decreases with the expansion of personal experience (Weinstein 1987; Reyna and Farley 2006), one of our aims is to examine how direct experiences with COVID-19 affect skepticism about the virus.

According to the psychometric approach to risk perception (Slovic 1987), the lack of knowing and controlling a source of risk, as well as potential catastrophic consequences can generate greater perceived risks, regardless of their actual size measured by probability and the volume of negative impact. In light of all this, the wholesale denial of dangers caused by COVID-19 was a considerably unexpected development among certain people, since the pandemic caused unprecedented health and other risks, as well a social and economical crisis. Here we can argue that the psychometric approach explains why people perceive different risks in different ways and not why they perceive the same risks in different ways (Siegrist et al. 2005). The theory of Renn et al. (1992) regarding the social amplification of risk offers an explanation as to why certain danger signals are tempered through psychological, social, institutional, and cultural processes. The model also provides a potential explanation as to why certain individuals deny the risks produced by dangerous events after interpreting them. For instance, if the decoded risk messages are not in sync with previous beliefs or they contradict the values professed by these individuals, they may disregard them. Some secondary economic and political effects can also weaken the perceived significance of information about risks.

According to Lewandowsky and Oberauer (2016), denial of or skepticism about scientific statements are mostly driven by motivated cognition. When people's fundamental convictions and worldview are in danger, they tend to question scientific results. Rutjens et al. (2021) argue that, while the different forms of skepticism can have different sources, skepticism regarding COVID-19 is very similar to climate change denial. In another study, these researchers came to the conclusion that the mistrust of vaccines and genetically modified foods negatively correlates with the extent of faith in science, but such a correlation cannot be found in the case of climate change denial (Rutjens et al. 2018). The authors suggest that people's worldview and religious identity can also feed into their skepticism, albeit to varying degrees. The present study examines, among other things, how different worldviews and the faith in science influence skepticism about the virus.

5.2. Methods

5.2.1. *Procedure and participants*

Survey participants were recruited from students enrolled in undergraduate and graduate degree courses at Corvinus University of Budapest. Students participated in the survey voluntarily and they were awarded extra credit in one of their courses for their participation. The survey was conducted online, the questionnaire was sent to the participants electronically, using the Qualtrics program. Because of the online format, we strove to filter out careless and hasty answers. Therefore, in the last item of the questionnaire, we asked participants whether their responses reflected their opinions adequately and whether they could be used in the research. In the course of the analysis, we disregarded the responses of those who answered no to this question, as well as the answers of those whose median response time was less than ten seconds. Out of the 464 fully completed questionnaires, we excluded three (N = 461). 71.6% of respondents were undergraduate students, their demographic distribution is M_{age} = 22 years, SD_{age} = 1.9 years; and the ratio of women was 67% in the valid

sample. The participants consented to have their answers used in the survey and our study has received the approval of the ethics committee of the university. The survey was conducted between 16–24 November 2020, when the number of new daily COVID-19 cases reached critical levels for the first time in the country. The course of the first and second waves of the pandemic in Hungary was similar to those in other Central European countries, except for some minor differences. During the first wave, the registered number of cases and fatalities was low compared to Western European countries, while strict restrictions were introduced. In the course of the second wave, starting in the fall of 2020, the rates of infections and fatalities were higher. For information on the course of the first two waves and their effects measured on a representative sample, see e. g. an article by Dudás and Szántó (2021), written at the same time as data collection for the present study took place. The time of data collection, of course, will significantly influence the results and will provide an important context for interpretation.

5.2.2. *Measurement method*

We have explored a range of factors as explanatory variables which, based on a review of relevant literature, we deemed to be potentially connected to opinions on preventative epidemiological measures. Therefore, our questionnaire featured questions about the worldview of the respondents (e. g. their individualism, their solidarity with society) and their trust in the competence of certain groups (e. g. whether scientists understand the pandemic properly or whether the government is able to handle it; whether others comply with preventative measures etc.). We measured the listed psychometric factors on a 7-point Likert scale. Furthermore, we collected data on respondents' experiences with the disease; the corresponding questions concerned whether the respondent or a person close to them (friend, family member) had contracted the virus prior to taking part in the survey. In the study, we used the expression "direct experience" for cases when participants contracted or believed to have contracted coronavirus themselves (35% of the valid sample), and we used the expression

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"indirect experience" when a family member or close friend had got infected (69%).

The students answered questions measuring their skepticism about COVID-19 on a 7-point Likert scale. The questions were phrased as follows: "To what extent do you agree with the... (statement)?" The statements were specifically selected for the present study and our aim was to grasp those COVID-skeptical arguments that were the most frequently used at the time of the data collection. We presented such viewpoints as 1. fatality statistics grossly overestimate the danger of the virus; 2. face masks are not effective; and 3. the economic damage caused by the restrictions is more severe than the health benefits thereof. At the time of the survey, there was no scientific consensus on the points we raised, and, at least in our opinion, voicing virus skeptical opinions may have influenced debates about the actual dangerousness of the coronavirus. The statements "labeled" as skeptical were couched in a way to emphasize that they are opinions and not facts (e. g. "there are people who believe..."; "many people think...").

To survey opinions on policies regarding the prevention of the spread of the disease, we integrated three such measures into the questions which were in effect at the time of the data collection (hand hygiene, social distancing, and mask mandates). Respondents' attitudes were also measured on a 7-point Likert scale. Figure 12 and Figure 13 in the Appendix presents the specific wording of the questions listed in the questionnaire, as well as the corresponding descriptive statistics.

5.2.3. *Data analysis*

Given, that the relationship of eight observed (pro-sociality, individualism, direct experience, indirect experience, trust in scientists, trust in government, trust in others, item ordering) and two latent variables (Covid skepticism, support for preventive policies) are in the focus of the research we used structural equation modeling (SEM) to assess our hypotheses. This method integrates various multivariate techniques and enables the analysis of relationships as well as the integrity of latent variables (Sajtos

and Fache 2005). Out of the two popular schools of SEM, we choose the covariance based modeling (CB-SEM), because on one hand our primary goal was detecting the mediating effect of Covid skepticism between the support for preventive policies and its other explanatory variables, and on the other hand, according to literature, this method is better in analysing relationship and testing hypotheses.(Henseler et al. 2009; Hair et al. 2011).

One of our hypotheses was that skepticism towards Covid-19 has a direct influence on support for preventive policies, while several factors (for example, individualism and pro-sociality linked to worldview orientation, trust in scientists, and indirect and direct experiences related to the virus) also exert their influence through skepticism. Regarding the other explanatory variables included in the model, we assumed that they are not influencing policy support through the level of skepticism, but exert an influence directly. The latter include the confidence of other citizens in the epidemiological discipline and the government's ability to manage the epidemic, as well as the order of the questions. The last one we considered important to include as a variable in the model because of the 'context effect' that can arise from the order of questions (Brecsok and Németh 2020). We handled this confounding effect by randomly arranging the question blocks, and to measure its effect, we introduced the variable indicating the sequence when designing the questionnaire, as is customary in political and psychological research (split ballot testing) (Gaines et al. 2007). We therefore randomly mixed the order of the question blocks belonging to the two latent variables and recorded whether the given participant had to evaluate the skeptical or the policy support statements first.

We also examined whether the effect from order of the question blocks or the trust in government moderates the relationship between Covid-skepticism and the support for preventive measures. We thought, that in the case of respondents with a more skeptical stance, the order of the question blocks may have a priming effect, but it may not be so in case of the less doubtful. Furthermore, we hypothesized that trust in the government is based on political affiliation, which can polarize people's opinions

about skeptical views on certain topics, as demonstrated by Campbell and Kay (2014), for example. To measure these effects, we created latent interaction variables using the double centering technique recommended by Lin et al. (2010) and incorporated them into the model one by one, examining the significance of the effects. Since we did not find these to be statistically significant, in the Results chapter we present models without the assumption of a moderating effect.

Before analysing the paths and fit of the SEM, we run reliability analysis on the measurement model, to test whether the items skepticism and policy support are consistent with the respective latent variables. In our research we treated the answers given on the 7-point Likert scales as ordinal variables and for this reason we calculated the reliability measures from polychoric correlations, rather than Pearson correlations, and used diagonally weighted least squares (DWLS) approach that is understood to work best with this kind of data (Muthen 1997; Flora and Curran 2004; Bandalos 2014). In addition, in case of reliability Cronbach's α indicators, we report the values obtained with the adjusted calculation method matching the ordinal variables based on Zumbo et al. (2007). All analyses were carried out in R, employing the semTools and lavaan packages (Jorgensen et al. 2021; Rosseel 2012), and analyses scripts can be found in the supplementary materials.

5.3. Results

5.3.1. Measurement model

Before fitting the model, we need to examine the validity indicators of the latent variables. It is important to evaluate internal and indicator reliability, convergence validity, and discriminant validity. (See Figure 9) Cronbach's α values adjusted for ordinal variables are 0.71 and 0.76, which exceed the acceptable limit (0.70). Due to the criticisms of this indicator (Sijtsma 2008; Borsboom 2006), we also tested the internal reliability with another measure. For a better estimate, we used the ω coeffi-

cient recommended by Flora (2020), and its value for Covid-skepticism and support for preventive measures are 0.68 and 0.76, respectively, i.e. in the case of skepticism, it is slightly lower than the desired value (0.70). To establish convergence validity, we calculated the value of the average variance extracted (AVE). This shows the extent of the variance captured by the latent variable compared to the variance resulting from measurement errors. The value of the AVE for Covid-skepticism is 0.46, and for elements supporting preventive measures 0.56. Although the former does not reach the limit value (0.50), it is still acceptable when combined with the relatively high α-value (above 0.70) (Fornell and Larcker 1981).

In terms of indicator reliability, both latent variables show adequate values (higher than the limit value of 0.5), since the standardized coefficients of the measurement items are between 0.61 and 0.76 for skepticism, and between 0.65 and 0.89 for the policy support measures. The squared value of these coefficients shows to what extent the variance of the latent variable is explained by the individual items, and we can conclude that all the items of the measurement model weigh sufficiently. The discriminant validity of the latent variables was evaluated using the HTMT indicator (heterotrait monotrait ratio) as defined by Henseler et al. (2015). The HTMT value between our latent variables is 0.73, which is below the threshold value of 0.85, i.e. we can consider it adequate. Based on the validity analysis, we obtained completely satisfactory results in the case of support for the measures, while in the case of skepticism, we experienced slightly less than desirable results in terms of internal validity and convergence validity. Since the discrepancy is not too large and in the case of skepticism, we used newly developed questions specifically worded to match the mood at the time of sampling due to the rapidly changing environment, we therefore consider the measurement model acceptable and fit the structural equation model using these two latent variables.

Statements used for latent constructs	Item loading	Cronbach-α	ω	AVE
Covid-skepticism		0,71	0,68	0,46
The dangerousness of the virus is grossly overestimated	0,608			
The use of face mask is unreasonable	0,760			
The economic damage from regulations are greater than the health benefits from them	0,650			
		0,76	0,76	0,56
Support for preventive policies				
Signs and icons suggest the use of hand disinfectant	0,649			
Mandatory face masks	0,887			
Signs and icons urge to keep safe distance	0,676			

Figure 9.: Indicators of the measurement model

5.3.2. *Structural equation model - SEM*

Figure 10 illustrates the results of the unstandardized model predicting support for preventive measures. According to the fit indicators, our model is adequate (the desirable value thresholds are indicated in parentheses): χ^2/df = 2.3 (< 3); CFI = 0.92 (> 0.9); TLI = 0.972 (> 0.95); SRMR$_{Bentler}$ = 0.071 (< 0.08); RMSEA = 0.053 (< 0.08), and the R^2 for latent variables are relatively high as well, 47 percent of the variance is explained by Covid skepticism, 61 percent in the case of support for preventive measures. In the model all hypothesized paths predicting a Covid-skeptic stance are significant (worldview, virus-related experiences, trust in scientists); from those listed mostly pro-sociality reduces and individualism increases skepticism. However, more important than this is that among the variables is Covid-skepticism is by far the strongest predictor of support for preventive measures. The advantage of the nonstandardized results is that they enable the interpretation of the path coefficients, so we can conclude that one unit of a shift on the scale measuring skepticism results in an average shift of 0.72 units in the opposite direction on the policy support. This confirms our assumption that the trivialization of the epidemic has a strong direct influence on the adoption of preventive epidemiological measures, and also allows us to conclude that it is also mediated by the examined effects of variables. The analysis of the mediating effects can be found in section 3.3. The path between the order of the questions and the support for the policies is also significant, so those, whose questionnaires included skeptical arguments first, were less likely to accept the pre-

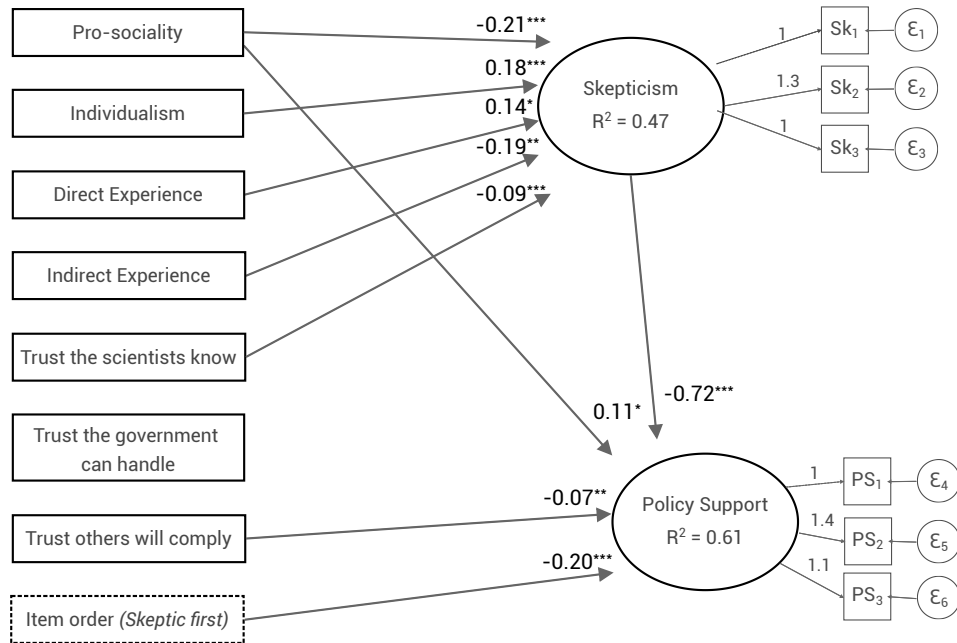**SEM predicting the support for epidemiological preventive measures [N = 461]**

Figure 10.: Note. * p < 0,05; ** p < 0,01; *** p < 0,001. The paths shown on the figure are statistically significant at the 95 percent level, the path coefficients indicated on them are the unstandardized model results. Observed variables are shown in rectangular boxes, while latent variables are shown in ovals. ε denotes the measurement error terms. A dashed text box highlights the order variable, which was not formulated as question but is an assigned parameter. The questions underlying the latent variables are referred to in the case of skeptical arguments by Sk_1 (overestimation of danger), Sk_2 (mask wearing is unreasonable) and Sk_3 (too great economic damage), and in the case of support for preventive measures, PS_1 (support for hand disinfection), PS_2 (support for mask wearing) and PS_3 (distance maintenance support)

ventive measures. The effect of trust in the compliance of the measures by others is also significant and in the opposite direction, which means that people support formal measures more, when they trust others less.

5.3.3. Mediation analysis

The SEM approach allows the direct, indirect and total effects of variables to be assessed. Table 12 shows the mediating effect exerted by Covid-skepticism between support for preventive measures and the observed variables. Although all antecedents

related to skepticism also indirectly significantly influences the support for preventive policies, in the case of dummy coded Covid19 experiences, the total effect is not significant, since their direct effect is in the opposite direction. In the case of worldview variables, we can establish full mediation for individualism and partial mediation for social solidarity, because the direct effect of the latter is also significant. With regard to trust in scientists, partial mediation occurs, as the indirect effect accounts for only approximately half of the total variance explained, despite the fact that the direct effect is not significant at the 95 percent level.

5.4. Conclusions

The results of our survey suggest that skepticism towards the coronavirus has considerable predictive power regarding the support for preventative epidemiological measures, which is in accord with the findings of other sources in the field. For instance, climate change denial correlates with lower acceptance rates of environmental measures (Huber 2020) and the use of renewable energy resources (Engels et al. 2013). Rutjens et al. (2021) contend that the nature and background factors of rejecting climate change and COVID vaccines are similar, just like those of COVID skepticism studied in the present survey. Our findings suggest that policy makers have to pay attention and react to counterarguments when formulating preventative epidemiological measures.

The measurable effect of the order of questions supports this idea: when skeptical arguments preceded those supporting preventative epidemiological measures in the questionnaire, respondents tended to believe less in the efficiency of these measures. Of course, it is debatable whether the position of respondents was based on this weak single stimulus or not, but our results still validate the evocative and priming effect of this stimulus. We can often find similar messages, for instance, on social media, which can have a significantly larger effect on opinions regarding preventative epidemiological measures. Since social support for such measures closely correlates

Table 12: Mediating effect of COVID skepticism between support for preventive epidemiological measures and its explanatory variables

Explanatory variable	Direct effect	Indirect effect	Total effect	Proportion mediated
Individualism	0.013	-0.127	-0.114	complete
	p = .648	p < .001 ***	p < .001 ***	mediation
Pro-sociality	0.106	0.151	0.257	partial
	p = .014 *	p < .001 ***	p < .001 ***	mediation
				(VAF = 0.588)
Direct experience	-0.034	-0.098	-0.132	no total effect
	p = 0.653	p = 0.048 *	p = 0.72	
Indirect experience	-0.023	0.139	0.116	no total effect
	p = 0.769	p = 0.008 **	p = 0.134	
Trust in scientists	0.053	0.062	0.115	partial
	p = 0.063	p = 0.001 **	p < .001 ***	mediation
				(VAF = 0.539)

Note. The data cells of the table show the value of the unstandardized coefficients and their corresponding values. The far right column shows the proportion of the total effect explained (mediated) by the indirect effect using VAF (variance accounted for) score. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

with rule-following (Franzen and Wöhner 2021), the spread of skeptical opinions can hinder effective protections against the pandemic.

The two worldviews we examined (individualism and social solidarity) are important influencers of COVID skepticism in our model. A high level of an attitude of solidarity decreases people's doubts, while an individualistic worldview tends to in-

crease it. Social solidarity can, at the same time, be a direct predictor of support for preventative epidemiological measures as well. This means that those people can also support preventative measures who are skeptical about the coronavirus, but they have solidarity for the rest of society. Recognizing this can be important for policy makers and governmental actors in charge of communications: in the fight against the coronavirus, it is worth emphasizing the values of social solidarity, the respect for the interest and rights of others, increasing the common good, as well as mutual help and responsibilities.

Direct and indirect experiences with the COVID-19 disease have diverse effects on the rejection of the coronavirus. For instance, if a family member or a friend contracts the disease, it will lower the level of skepticism, while direct experiences tend to increase it. In our view, these differences can be explained by the make-up of our sample, as young adults, if they contracted the disease in the first wave of the pandemic, they tended to exhibit only mild symptoms and the fatality rate was also very low among them (Bhopal et al. 2021). And the phenomenon that their own experiences did not reflect the real social dangers only increased their rejection. The relatives of our subjects, however, were more likely to be older, and the more severe course of their illness could leave a greater impression on our young respondents.

A lack of faith in scientists is another important source of COVID skepticism. Those who think that scientists do not or only partially possess relevant knowledge about the coronavirus are more suitable to skeptical opinions. Our results are in accord with the findings of other researchers. Rutjens et al. (2018) have found similar negative correlations between faith in science and climate change denial and the rejection of eating genetically modified foods. The contribution of faith in scientists to the greater support of policy measures can only be partially explained by its effect on COVID skepticism. Thus, those who are less skeptical about the COVID-19 epidemic will continue to support preventative measures if they have trust in the word of scientists. This leads us to believe that the credibility of virologists and epidemiologists is a prominent factor if we want to increase the acceptance of anti-pandemic measures.

When it comes to the trust in others' compliance with such measures, we have found the opposite effect than the one we had anticipated. Originally, we thought that people would be more willing to accept preventative measures if they believed that others also acted in accordance with these regulations, trusting in the efficiency of such measures. Our findings, however, contradicted this hypothesis: when people trust others less, they demand stricter regulations to curtail the spread of the virus and guarantee their own safety, and they want the government to enforce such regulations (we have found a negative correlation between trust in others and the support for measures).

It is worth mentioning two important limits to our study. Our sample consisted of young adults taking part in higher education, which therefore does not represent the entire Hungarian population. Thus, the absolute values of the metrics in our study are less interesting than the correlations between the factors. Furthermore, we have to take into consideration the fact that, due to the timing of the survey, the data refer to only a short period of a pandemic with an inconsistent course, this period being the escalating part of the second wave, which provides a specific context for the results.

Explanatory variable	Standardised coefficient (β)		z-value		P(>|z|)	
	Support for preventive policies	Covid-skepticism	Support for preventive policies	Covid-skepticism	Support for preventive policies	Covid-skepticism
Individualism	0,013	0,176	0,456	7,074	0,648	0
Pro-sociality	0,106	−0,209	2,457	−5,582	0,014	0
Direct experience	−0,034	0,136	−0,450	2,03	0,653	0,042
Indirect experience	−0,023	−0,192	−0,294	−2,738	0,769	0,006
Trust in scientists knowledge	0,053	−0,086	1,86	−3,579	0,063	0
Trust the government can handle the pandemic	−0,022		−0,835		0,404	
Trust others will comply with policies	−0,065		−2,324		0,02	
Item order (skeptic first)	−0,195		−2,761		0,006	
Covid-skepticism	−0,722		−6,698		0	

Figure 11.: Coefficients of SEM paths

Question	Scale	Mean	St.dev.
What is your gender?			
− female (%)		66,60	
− male (%)		33,40	
What is your age (years)		22	1,9
Which level of higher education are you enrolled in?			
− bachelor (%)		71,60	
− master (%)		28,50	
To what extent do you think it's important to do things for the benefit of others and society even if they have some costs to you personally?	7-point Likert-scale (1 = strongly disagree; 7 = strongly agree)	5,9	1
What do you think about the following statement? The government interferes far too much in our everyday lives.		3,6	1,6
To what extent do you agree with the following statement? The scientists understand and interpret the pandemic quite well		4,5	1,3
How much do you trust the Hungarian government to deal effectively with the coronavirus pandemic in Hungary?	7-point Likert-scale (1 = not trust at all; 7 = trust very much)	3,7	1,5
How much do you trust the Hungarian citizens to comply with the regulations related to the coronavirus pandemic?		3,9	1,4
Please, pick the statement that describes your situation the most			
- No suspicion arose yet that I have or had coronavirus earlier (coded for analysis: 0) (%)		64,70	
- I think, I had coronavirus earlier, but it was never tested (coded for analysis: 1) (%)		28,70	
- A physician confirmed that I had coronavirus earlier (coded for analysis: 1) (%)		6,70	
To your best knowledge was there anyone in your immediate environment (family, close friends) coronavirus infection?			
− Yes (%)		69,20	
− No (%)		30,80	

Figure 12.: Survey questions and the relevant descriptive statistics 1/2

Skepticism		Mean	St.dev.
Many people think that the dangerousness of the coronavirus is greatly overestimated because the deaths-to-cases ratio is not reported accurately. People dying of a serious, pre-existing disease are unnecessarily attributed as casualty of the virus, moreover, many cases are not accounted for in the statistics. Therefore, the dangerousness of the virus seems greater by orders of magnitude than it really is. To what extent do you agree with the above statement?	7-point Likert-scale (1 = strongly disagree; 7 = strongly agree)	4,5	1,6
Some say that the mandate to wear masks is an unnecessary burden. The reason, is that the everyday use is unrealistic, since people will not wear them properly (covering nose and mouth). Besides, the particles of the virus are much smaller, than what the textile of the most frequently used masks could filter. To what extent do you agree with the above statements?		2,6	1,5
Many are on the opinion that the damage to the economy caused by the restrictions (for example the drastic decline for tourism, catering and entertainment sectors) are much more severe, than the public health preserving benefits from them. To what extent do you agree with the above statement?		4,1	1,6
Policy support			
To what extent do you support the following measure: At the entrance of public places (for example in public buildings or shopping malls) painted footprints on the floor lead to sanitizers with colorful instructions	7-point Likert-scale (1 = strongly oppose; 7 = strongly support)	5,8	1,1
To what extent do you support the following measure: People are not allowed to enter public places (for example in public buildings or shopping malls) without wearing mask hiding their nose and mouth		5,1	1,5
To what extent do you support the following measure: In public places (for example in public buildings or shopping malls) stickers on the floor show 1.5-meter distance, to notify about the importance of social distancing		5	1,5

Figure 13.: Survey questions and the relevant descriptive statistics 2/2

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6. Study V. COVID-19 skepticism and the perception of risk

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Abstract

The importance of researching public support for preventive policies have been amplified by the COVID-19 pandemic. Using a representative sample of the Hungarian population, we investigated the support for commonly used preventive measures (social distancing, hand hygiene and wearing masks) comparing two different policy tools (nudges and regulations). Because of the high risk and unfamiliarity of the pandemic, the respondents' risk perception and experience with the disease was also assessed. All preventive measures were generally supported and, contrary to the findings of previous nudge research, there was no clear pattern whether regulations or nudges are preferred. People with higher level of risk perception supported both types of policies more but slightly favoured the regulations. Those who had contact with the disease (either themselves or a close friend or family member contracting COVID-19) reported a higher level of risk perception. When the person themselves was afflicted, this higher levels of risk perception did not translate to a higher level of support, moreover, it even decreased support for the regulations according to regression analysis. In case of a loved one contracting the disease, there was an increased support for both

types of measures, but that is explained by the higher risk perception.

6.1. Introduction

The COVID-19 pandemic has created a global phenomenon that has attracted the attention of numerous researchers in the field of risk assessment. Some societies have never seen such an unprecedented health crisis before (Rubaltelli et al. 2020), and such eclectic and extreme human reactions to the elevated level of risk. The media has reported daily about the progress of the pandemic, the ever-increasing number of incidences, the death toll, and the more and more austere policy measures that governments have introduced throughout the world to tackle the pandemic. Our understanding of what influences risk perception might have become more critical than ever before in modern history. If one wants to understand people's reaction to the pandemic, risk perception studies should be re-investigated and sometimes re-interpreted.

The reactions to the pandemic vary from total dread and extreme level of fear and frustration to the negligence of risk messages (Koon et al. 2021). There have also been some extremes like the denial of the risk and sometimes the disease itself (Hakim et al. 2021). Why do we see such a wide spectrum of responses to the coronavirus crisis? We saw that these reactions have changed over time during the pandemic (Bazzi et al. 2021; Jørgensen et al. 2021). Findings from laboratory experiments confirm that in case of rare risk events even careful subjects get complacent over time, and they start behaving that 'it won't happen to me' (Erev et al. 2020). Several researchers hypothesized that COVID skepticism could play an important role in the formation of risk perception of the public. Skepticism with the disease and the risks were not exceptions, but in social media one could have frequently encountered virus skeptic messages.

Previously, the relationship between COVID skepticism and corresponding risk perceptions were not yet studied in the literature. COVID skeptic messages are

widespread, particularly in the social media, therefore for policy makers it is essential to understand what attitudes people who are more receptive to these messages will develop and what risk they perceive. In our view, the reactions of COVID skeptics can greatly undermine the success of the preventive measures against the spread of the disease since virus skeptic people may comply less with COVID related measures and they engage in more high contact behaviors, therefore we should also find out what psychological factors may fuel COVID skepticism. Studying antecedents of COVID skepticism and its relationship with risk perception could be critical for policy makers combating with the coronavirus.

With this study our aim is threefold. First, to apply previously established theories and to collect empirical evidence on the antecedents of risk perception in the context of the COVID-19 pandemic. Second, to extend the existing models on risk perception with an assessment of COVID skepticism and investigate its role in influencing risk perception and whether it mediates its antecedents. Third, to perform a longitudinal analysis on the lasting effects between COVID skepticism and risk perception and the potential antecedents of both.

6.1.1. *Skepticism, denial and relativization*

Risk denial theory was developed by Peretti-Watel (2003) as an updated variant of the neutralization theory (Sykes and Matza, 1957) which describes how wrongdoings are neutralized by offenders. Peretti-Watel et al. (2007) argue that individuals exhibiting risky behaviors the society condemn such as smoking or heavy alcohol use, don't just perceive the risk in a distorted way, but they deny the risky label of their behavior. Bocquier et al. (2017) use the term risk relativization along with risk denial. Risk relativization is interpreted as a comparison between the actual risk factor and a similar risk that has been already accepted. When exploring risk perceptions of cancer related to alcohol consumption, they found a higher level of risk denial and risk relativization among men, and older generations, and the risk relativization score predicted a higher

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level of daily drinking as well. Guastafierro et al. (2021) found that older adults perceived COVID-19 related risks lower than the risks associated with common flu at the early stage of the pandemic, when the number of cases were relatively low compared to the figures in the second or the third wave.

Hakim et al. (2021) introduced the term disease denial in connection with the COVID-19 pandemic. In their view, disease denial is a non-belief in the disease, or people rationalizing the negative effects of the epidemic. Latkin et al. (2021, p. 1) conceptualized COVID skepticism as the "denial of the seriousness of the illness and the perception that the pandemic is overblown or a hoax". Lewandowsky and Oberauer (2016) argue that similar variations of risk skepticism appear across different domains from tobacco use and climate change to the COVID-19 pandemic. COVID skeptics usually use different arguments when they diminish/minimize the significance of the pandemic from the ones that were proposed by earlier risk denial theories (Peretti-Watel 2003; Bocquier et al. 2017). COVID skeptics often claim that official statistics are not meaningful or even lies. They do not believe in the effectiveness of preventive measures such mask wearing, hand sanitization, and social distancing, and they consider negative economic consequences larger than the benefits that preventive measures bring to the society. One must note that phrases like risk denial, neutralization, relativization and skepticism are often used interchangeably in the literature. Since these phrases are understood on the same scale, with slightly different severity, in the following sections of this study we use the term skepticism to refer to this phenomenon.

6.1.2. Potential explanations for skepticism

Needleman (1987) wrote back in the 80s that overreaction to risk information had received much more attention from researchers than under-reaction when certain individuals lessen risks that concern them greatly. As she puts it: "people are subject to influences and limits from their social environment; they may periodically rethink their

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risk decisions; they may react to risk information with denial, cynicism, or fatalism" (Needleman 1987, p. 22). From a psychological perspective risk skepticism can be explained with excessive optimism. Optimistic bias in risk perception occurs when one may believe that he or she is less exposed to a harmful consequence than their peers (Weinstein 1989). Costa-Font et al. (2009) found evidence for optimism towards unfamiliar risks as well generating a smaller risk perceived. A recent study based on a US sample demonstrated that optimistically biased people perceived COVID-19 related risks lower, generating a modest level of risk response (Park et al. 2021). Since various studies show that unrealistic optimism decreases with personal experience (Weinstein 1987; Reyna and Farley 2006), we wanted to assess whether firsthand experience with COVID-19 influences skepticism.

The psychometric paradigm of risk perception (Slovic 1987) suggests that a lack of familiarity with and control of a risk source, and potential catastrophic consequences, indicate higher risk perceptions regardless of the actual size of the risk in terms of probabilities and volumes. Therefore, risk denial related to COVID-19 was fairly unexpected since the pandemic brought unprecedentedly high risk and a social and economic crisis. One can argue, however, that the psychometric paradigm attempts to explain why various risks are perceived differently, and not why people perceive the same risk differently (Siegrist, Keller and Kiers 2005). Renn et al. (1992) argue that their concept of social amplification of risk can explain why certain signals of risks are attenuated through psychological, social, institutional, and cultural processes. The model can explain why certain individuals' interpretation of hazardous events result in denial. For example, if decoded risk messages are inconsistent with prior beliefs or contradict the values of these people, they may ignore these messages. Some secondary economic and political impacts can also attenuate risk information.

Lewandowsky and Oberauer (2016) argue that science denial or skepticism is mainly driven by motivated cognition. When people's core beliefs and worldviews are threatened, they tend to question scientific findings. Rutjens, van der Linden and van der Lee (2021) claim that various forms of skepticism may have different an-

tecedents, but skepticism about COVID-19 is similar to climate change denial. In another study researchers found evidence that vaccine skepticism and genetically modified food skepticism are associated with faith in science, but this link was missing in the case of climate change skepticism. According to the same research some specific worldviews and religious identities can fuel skepticism, but to a different degree (Rutjens et al. 2018). In this study we tested how worldviews and trust in science influence COVID skepticism.

6.1.3. *Antecedents of risk perception*

Past research has revealed various antecedents of risk perception such as trust, gender, worldviews and value orientations (for a comprehensive review, see the summary of Siegrist and Árvai 2020). In this section we present some relevant studies we relied upon when we formulated our research model. There is a wide consensus that trust plays a crucial role in the formation of risk perception. Siegrist, Gutscher and Earle (2005) claim that general trust along with confidence negatively influences risk perception. Similarly, Terpstra (2011), when analyzing flood risk perceptions in the Netherlands, found that trust in flood protection (risk management authorities and flood defense) lessened perceived dread, the perceived consequences, and likelihood of negative events in the future. Studies looked at various forms of trust such as trust in government or authorities, trust in scientists and technologies, trust in others, and many others. A recent study confirms that trust in government negatively correlates with risk perception concerning natural hazards (Han et al. 2021). Smith and Mayer (2018) differentiate between institutional trust (e.g. in governments, courts) and social trust (in various groups of people) when they studied how trust and risk perception influences climate change ameliorative behavior and policy support.

Trust was shown to influence risk perception in the COVID-19 context specifically by Siegrist et al. (2021). Among those who had higher social trust, the COVID related risk perception was higher, it is important to note, however, that social trust in their

study was measured with items like trust in government, authorities and the pharmaceutical industry. A variable representing trust in scientists/experts was also added to the list of key factors influencing risk perception by van der Linden (2015), while trust in science and in medical professionals were significant predictors for COVID related risk perception in the pooled model of Dryhurst et al. (2020). The role of scientists and medical experts in the struggle against COVID-19 looks unquestionable, hence we assumed that trust in these professionals is associated with COVID related risk perception.

Women generally perceive more risk than males (see Siegrist, Gutscher and Earle 2005, for confirming evidence). According to most studies women are usually more sensitive to the risks associated with health and ecological hazards which can be explained by several factors such as women caring more about future generations, and they view themselves as more vulnerable to these hazards (Rivers et al. 2010). Gender differences seem to hold in the case of the COVID-19 pandemic too, with females considering themselves more vulnerable and perceive larger risks (Yıldırım et al. 2021; Ding et al. 2020; Siegrist et al. 2021).

Cultural theory of risk argues that people holding different worldviews also tend to perceive risk differently (Douglas and Wildavsky 1983). Although studies thriving to confirm cultural theories have produced mixed results in the last four decades, there are two specific fields of risk perception research (climate change and nuclear power) where worldviews have seemed to have significant effects on how risks are perceived (Siegrist and Árvai 2020). In a comparative study individualism and pro-sociality proved to be the two most important predictors of COVID related risk perception; individualistic worldviews explained 4.78% of the total variance, while pro-sociality explained 3.91% in the pooled model (Dryhurst et al. 2020). Following these findings, variables on individualistic and pro-social worldviews were included into this research. With that, we included much of the wide range of predictors used by Dryhurst et al. (2020) to model COVID related risk perception, but their model did not investigate the role of skepticism. Since we expected that a skeptical stance will con-

tribute to COVID-19 risk perception, we extended the work of Dryhurst et al. (2020) in a new direction and also modeled COVID skepticism as a predictor of risk perception. Since worldviews may have effects both on risk perception and skepticism according to previous research, we built our regression models with the assumption that worldviews influence risk perception through skepticism as a mediating factor.

6.2. Method

6.2.1. *Participants and procedure*

We recruited research participants among students enrolled in a regular BA or MA program of a Hungarian university. The students participated in the research voluntarily, for course credit. Our initial data collection took place between the 16th and 24th November 2020 (the rapidly escalating part of the second COVID-19 wave), which then we repeated with the same set of items between the 20th and 27th September 2021 (the beginning of the fourth COVID-19 wave).

The spread of COVID-19 hit Hungary in multiple waves starting in the spring of 2020. In the first wave Hungary saw very small number of cases and fatalities compared to Western European countries, but restrictions and even a full lockdown were nonetheless in place. The preventive measures were then eased during the summer and only brought back when the second wave hit. In the autumn of 2020, incident rates and fatalities rose to high levels, which were then topped by the third wave in the spring of 2021 (see Dudás and Szántó (2021) for a review on strictness of preventive measures and related attitudes up until the second wave). The country saw a fourth wave of the pandemic in the Fall of 2021 similarly to the second wave a year before with even higher incident rates, but lower fatality figures. A notable difference between the two waves and the times of data collection is that vaccination became available for the members of the public in 2021. See Figure 14 for more context on the course of the pandemic in the country.
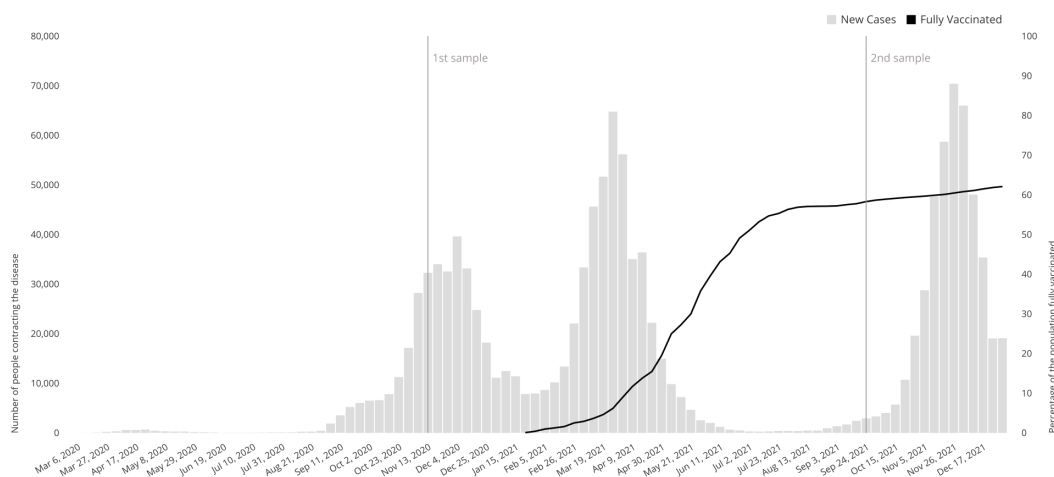
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The Course of COVID-19 in Hungary

Figure 14.: The figure shows the new cases of COVID-19 and the cumulative proportion of the fully vaccinated population from early 2020, when the pandemic reached Hungary, throughout the first four waves until the end of 2021. The time of data collection for this study is also annotated on the figure.

An online survey design was applied, and the questionnaire was administered and distributed electronically using Qualtrics both of the times. Because of the online nature of the survey, we took care to exclude inattentive respondents. The last item of the survey inquired whether the answers given reflected the respondent's opinion well, and they are applicable for the research. Combined with this self-reported validity check we also applied a filter, excluding the respondent if the response time for the survey was less than a minimum time of three and a half minutes. After exclusions our valid samples consisted of $N_{20} = 461$ and $N_{21} = 403$ in the two years respectively. All participants provided informed consent. The research had received the relevant university ethics approval.

6.2.2. Measures

We used a set of items adapted from the study of Dryhurst et al. (2020) specifically defined to measure COVID related risk perception as an index, considering affective, cognitive, and temporal-spatial dimensions as well. These items inquired about the (1) general worry, (2) the spread of virus, (3) the seriousness of the sickness, (4) perceived

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likelihood of close family members contracting the virus (5) perceived likelihood of personally contracting the virus, and (6) perceived likelihood of personally getting sick from the virus. All items were assessed on a 7-point scale (see Table 13 for survey items and descriptive statistics). As we were interested in examining the antecedents of risk perception for which a well rounded generalized score is useful (similarly to the studies of Siegrist et al. 2021; Dryhurst et al. 2020), we constructed the risk perception index as the average value of all six items, instead of distinguishing between items that correspond to individual or societal risk. To test the reliability of using these items relating to the same construct, we calculated the alpha coefficient based on polychoric correlations since the items were measured on an ordinal scale. In the two samples respectively we report $\alpha_{20} = 0.72$ and $\alpha_{21} = 0.78$, which are above the desired threshold (0.7) and fall within the range Dryhurst et al. (2020) reported for the same items using representative samples across countries. The overall levels of perceived risk for the queried items were fairly high at the time of our first sample. Our young adult respondents rated the chance of others being affected higher than themselves being affected. We see a substantial reduction in perceived risk by the time of the second sample for all but one of the items we queried. The perceived severity of the disease did not decrease, meaning that the lower risk perception can be fully attributed to the spread of the virus slowing down.

For the COVID skepticism items participants had to respond on a 7-point scale; "to what extent they agree..." with the presented skeptical statements. These statements were developed specifically for this study with the aim to capture the sentiment of the most frequently used COVID skeptic reasonings at the time of data collection. Similarly to Latkin et al. (2021) the items included claims around (1) the dangerousness of the coronavirus, (2) the face masks, and (3) the damage the restrictions cause to the economy. See Table 14 for the items and descriptive statistics. The skepticism index was also calculated as the average of these items. The reliability coefficients in the two samples were measured as $\alpha_{20} = 0.71$ and $\alpha_{21} = 0.72$ for the skepticism items, measured also based on polychoric correlations. One of the skepticism items in our

Table 13: The items and descriptive measures for COVID related risk perception

Survey items, measured on 7-point Likert scale (answer options represented in brackets)	'20-Nov Mean (SD)	'21-Sep Mean (SD)
How worried are you personally about the coronavirus epidemic? (not at all worried - very worried)	4.3 (1.5)	3.5 (1.5)
The coronavirus will NOT affect very many people in Hungary. [reverse coded] (strongly disagree - strongly agree)	6.2 (1.0)	5.1 (1.4)
Getting sick with the coronavirus can be serious. (strongly disagree - strongly agree)	5.8 (1.1)	6.0 (1.2)
How likely do you think it is that your family members or close friends in Hungary will catch the coronavirus in the next 6 months? (not at all likely - very likely)	5.9 (1.2)	4.4 (1.5)
How likely do you think it is that you will catch the coronavirus in the next 6 months? (not at all likely - very likely)	4.7 (1.4)	3.5 (1.4)
I will probably get sick with the coronavirus in the next 6 months. (strongly disagree - strongly agree)	4.3 (1.5)	3.1 (1.4)

samples was generally more accepted, averaging above the midpoint on the scale. Respondents agreed on average with the dangerousness of the virus being overestimated statement, while they were on the fence with the item; restrictions cause more damage to the economy than what health benefits they result. Agreement with both had decreased slightly by the time of the second sample, when restrictions were less strict and by which time we gained more information on the impact of the pandemic. The third item, that mask wearing is unnecessary, was on average rather disagreed with.

Mask wearing was mandatory indoors and on public transport at time of our first sample, so the respondents generally approved that. Their views has changed slightly by the second sample, at which point the mandates on mask wearing were lifted.

Psychological predictors of risk perception were directly measured with a single item. These included questions measured on a 7-point scale about the respondent's worldviews: pro-social attitude (mean and standard deviation in '20-Nov sample: 5.9 [1.0]; in '21-Sep sample 5.6 [1.1]), individualist worldview (3.6 [1.6]; 3.8 [1.5]); as well as their trust toward certain people or institutions: that scientists have a good understanding of the pandemic (4.5 [1.3]; 5.0 [1.3]), the government is able to handle the pandemic (3.7 [1.5]; 4.0 [1.4]), and other people will comply with the preventive regulations (3.9 [1.4]; 3.4 [1.3]). Besides these, we also collected data on the respondent's experience with the disease. The questions inquired whether the respondent or someone close to them (friend or family member) had contracted COVID-19. For the purposes of this study, we use the phrasing 'direct experience' when the participant contracted or believed to had contracted COVID-19 (35% and 45% in the two samples respectively), and the phrasing 'indirect experience' when a family member or close friend had contracted the virus (69% and 84%). The exact wording of the items can be found in the supplementary materials.

6.2.3. Data Analysis

We fitted linear regression models for both samples using the index variables for risk perception and skepticism. We applied the regression model first on the conceptualized mediator variable (COVID skepticism) with a reduced set of antecedents. The assumed predictors of COVID skepticism were the respondent's worldview, experience with the virus and trust in scientists' variables as predictors. Trust in the governments ability to contain the disease and the trust that others will comply with the preventive measures were not considered as explanatory variables for skepticism. We argue that those who are skeptical about the dangers of COVID-19 are indifferent

Table 14: The items and descriptive measures for COVID skepticism

Survey items, measured on 7-point Likert scale (answer options represented in brackets)	'20-Nov Mean (SD)	'21-Sep Mean (SD)
The dangerousness of the coronavirus is greatly overestimated. (not agree at all - fully agree)	4.5 (1.6)	4.2 (1.6)
Imposing mandatory mask wearing is unnecessary. (not agree at all - fully agree)	2.6 (1.5)	2.9 (1.6)
The damage to the economy caused by the restrictions are much more severe, than their benefits of health preservation. (not agree at all - fully agree)	4.1 (1.6)	3.9 (1.6)

toward these containment efforts. Although gender is a well known predictor of risk perception it was also omitted from the explanatory variables of skepticism, because it's association to risk perception is rooted in a deeper, sociocultural level rather than being context dependent. In a second step, we regressed our main dependent variable (risk perception) on the mediator (skepticism), all of the mediators predictors and the remaining antecedents; trust in others, trust in government and gender.

Model diagnostic steps included checking VIF scores for multi-collinearity between variables (all below 1.5), conducting Durbin-Watson test finding no autocorrelation, confirming normal distribution of residuals as well as the presence of influential outliers by visually analyzing distribution plots. We also tested the robustness of both the mediator's and dependent variable's regression models using robust standard errors. Results were consistent with the OLS regressions reported in the next section. We carried out the statistical analysis of our data in the R software and all the analysis scripts can be found among the supplementary materials. For the mediation analysis we used the 'mediation' package developed by Tingley et al. (2014) specifically for causal mediation analysis. We performed a simulation separately for each

of the five variables (individualism, pro-sociality, direct and indirect experience, trust in scientists) assumed to be mediated by skepticism. For the mediation analyses and the relative variable importance calculations we applied bootstrapping methods with 5000 simulations to get robust estimates and the 95% confidence intervals.

6.3. Results

We report the fitted regression models for COVID skepticism and risk perception in Table 15 and Table 16, and provide a visual representation for the estimated coefficients of independent variables' predicting the risk perception with Figure 15. The model with skepticism as the dependent variable indicates that the respondent's worldviews (individualism $\beta_{20} = 0.26^{***}$, $\beta_{21} = 0.28^{***}$; pro-sociality $\beta_{20} = -0.33^{***}$, $\beta_{21} = -0.4^{***}$) and trust in scientists ($\beta_{20} = -0.11^{**}$, $\beta_{21} = -0.14^{***}$) are all significantly associated with skepticism in both samples. The indirect experience ($\beta_{20} = -0.31^{**}$, $\beta_{21} = 0.23$) although significant in the 2020 September sample, but loses its association to skepticism as this binary property gets more saturated in the second sample. Although only marginally significant at the first point of data collection, it is interesting that the direct experience is estimated to increase skepticism ($\beta_{20} = 0.17$, $\beta_{21} = 0.25^{*}$). In this regard it is noteworthy, that our sample consisted of young adults, whom after contracting the disease may have found the symptoms much less severe than they anticipated.

The model predicting risk perception shows, that having pro-social values ($\beta_{20} = 0.111^{**}$, $\beta_{21} = 0.176^{**}$), having a direct experience with the virus ($\beta_{20} = 0.158^{*}$, $\beta_{21} = 0.243^{**}$) are significantly associated with higher levels of risk perception in both samples, while skepticism ($\beta_{20} = -0.165^{***}$, $\beta_{21} = -0.259^{***}$) has a significant opposite effect. A range of predictors, namely the indirect experience ($\beta_{20} = 0.179^{*}$, $\beta_{21} = 0.203$), trusting that the government can handle the pandemic ($\beta_{20} = -0.071^{**}$, $\beta_{21} = -0.015$), trusting the scientists knowledge ($\beta_{20} = 0.077^{**}$, $\beta_{21} = 0.034$) and gender ($\beta_{20} = -0.332^{***}$, $\beta_{21} = -0.064$) had a significant association with risk perception in

Table 15: Linear regression models for risk perception

	Risk Perception '20-Nov			Risk Perception '21-Sep		
	Est.(β)	St.Err.	Pr (> $|t|$)	Est.(β)	St.Err.	Pr (> $|t|$)
Skepticism	-0.165	0.034	< 0.001 ***	-0.259	0.042	< 0.001 ***
Individualism	-0.034	0.026	0.200	0.084	0.033	0.012 *
Pro-sociality	0.111	0.041	0.006 **	0.176	0.043	< 0.001 ***
Direct Experience	0.158	0.074	0.034 *	0.243	0.087	0.005 **
Indirect Experience	0.179	0.076	0.020 *	0.203	0.119	0.089 .
Trust Scientists	0.077	0.027	0.005 **	0.034	0.036	0.345
Trust Government	-0.071	0.025	0.005 **	-0.015	0.033	0.644
Trust Others	-0.006	0.027	0.815	-0.089	0.035	0.013 *
Gender (Male)	-0.332	0.073	< 0.001 ***	-0.064	0.088	0.469
(Intercept)	5.153	0.362	< 0.001 ***	3.841	0.422	< 0.001 ***
F statistic and DF	15.69 (9, 451)			14.54 (9, 393)		
Prob > F	< 0.001 ***			< 0.001 ***		
adj. R^2	0.223			0.233		

Note: The table reports the estimates, standard errors and statistical significance of the independent variables for the four models where the outcome variable is skepticism and risk perception respectively (meaning their calculated index variable) from the two examined periods. The categorical experience variables were specified as dummy (1/0). Significance levels are denoted with (.) when $p < 0.10$; (*) when $p < 0.05$; (**) when $p < 0.01$; (***) when $p < 0.001$.

the November 2020 model, but it was not the case in the September 2021 model. The only variable which emerged with our second sample as a significant predictor of risk

Table 16: Linear regression models for skepticism

	Skepticism '20-Nov			Skepticism '21-Sep		
	Est.(β)	St.Err.	Pr ($> \lvert t \rvert$)	Est.(β)	St.Err.	Pr ($> \lvert t \rvert$)
Individualism	0.263	0.033	< 0.001 ***	0.281	0.035	< 0.001 ***
Pro-sociality	-0.330	0.054	< 0.001 ***	-0.398	0.047	< 0.001 ***
Direct Experience	0.174	0.103	0.093 .	0.246	0.104	0.018 *
Indirect Experience	-0.314	0.106	0.003 **	0.225	0.143	0.116
Trust Scientists	-0.114	0.037	0.002 **	-0.144	0.042	< 0.001 ***
(Intercept)	5.413	0.412	< 0.001 ***	5.242	0.385	< 0.001 ***
F statistic and DF	43.17 (5, 455)			50.25 (5, 397)		
Prob $>$ F	< 0.001 ***			< 0.001 ***		
adj. R^2	0.314			0.380		

Note: The table reports the estimates, standard errors and statistical significance of the independent variables for the four models where the outcome variable is skepticism and risk perception respectively (meaning their calculated index variable) from the two examined periods. The categorical experience variables were specified as dummy (1/0). Significance levels are denoted with (.) when p $<$ 0.10; (*) when p $<$ 0.05; (**) when p $<$ 0.01; (***) when p $<$ 0.001.

perception, that did not have such an association in the first sample, is trusting that others comply with preventive measures (β_{20} = -0.006, β_{21} = -0.089*)

The coefficients of a multiple regression model like those above are informative, but as the recommended practice for researchers is to supplement regression analyses with variable importance indicators (Darlington 1968; Tonidandel and LeBreton 2011), we report the estimation of relative contribution by the predictor variables to risk perception in Table 17. We followed the method of Lindeman et al. (1980, p. 119) which

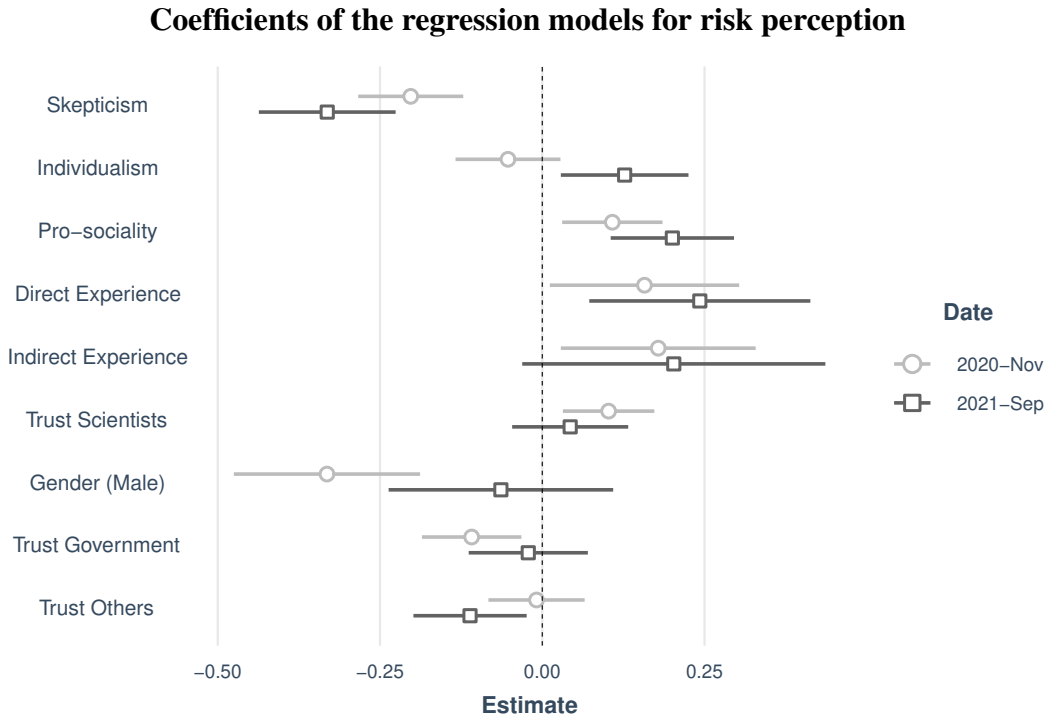**Coefficients of the regression models for risk perception**

Figure 15.: The figure reports the standardized coefficients from the linear regression models with risk perception index as dependent variable. The horizontal lines spanning from the estimated value represent 95% confidence intervals.

is a computer intensive method based on variance decomposition. Skepticism has by far the strongest influence on risk perception in both samples, accounting for 33.8% (confidence interval: 22%-51%) and 43.2% (32%-59%) of the variance explained by the models. The other variable which was relatively important in both sample is pro-sociality (17.3% [9%-31%], 30.6% [19%-48%]). Apart from the above mentioned variables, only the relative importance of direct experience (2.7% [0%-10%], 5.4% [1%-16%]) and trusting others (1.7% [0%-8%], 8.6% [2%-21%]) increases from the 2020 November sample to the 2021 September sample, while the importance of the other variables diminishes considerably. We can notice a comparably high (7.3% [1%-19%]) relative importance for individualistic worldview in the first sample, which is curious, because the association between individualism and risk perception was not significant in the linear model (β_{20} = -0.034). Oppositely, individualism had a fairly strong association in 2021 (β_{21} = 0.084*) as did the direct experience in both years (β_{20} = 0.158*, β_{21} = 0.243**), but they still had low relative importance 3.3% (2%-

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6%) for individualism in 2021, 2.7% (0%-10%) and 5.4% (1%-16%) for direct experience in the two models respectively. We conducted a mediation analysis to shed more light on the effects the predictor variables have directly on risk perception, and indirectly through the mediating effect of skepticism.

Table 17: Relative importance of variables predicting risk perception

	2020 November		2021 September	
	Pct. of R^2	Conf.Int.	Pct. of R^2	Conf.Int.
Skepticism	33.8%	[22%-51%]	43.2%	[32%-59%]
Individualism	9.0%	[4%-20%]	3.3%	[2%-6%]
Pro-sociality	17.3%	[9%-31%]	30.6%	[19%-48%]
Direct Experience	2.7%	[0%-10%]	5.4%	[1%-16%]
Indirect Experience	7.3%	[1%-19%]	2.4%	[2%-9%]
Trust Scientists	8.4%	[2%-20%]	4.5%	[1%-15%]
Trust Government	5.9%	[1%-17%]	1.6%	[0%-8%]
Trust Others	1.7%	[0%-8%]	8.6%	[2%-21%]
Gender	14.1%	[6%-28%]	0.4%	[0%-3%]

Note: The table reports the relative variable importance in the regression model fitted with the risk perception index as the dependent variable. The percentages representing relative importance are normalized and attribute for the total R-squared explained by the model. The represented confidence intervals correspond to the 95% level.

6.3.1. *Mediation analysis*

We ran mediation analyses with non-parametric bootstrapping to test the mediating effect of skepticism between the psychological predictors and risk perception. The results are reported in Table 18. The mediation analysis confirms that the respondents' worldviews have a strong association with risk perception indirectly, meaning they are mediated through skepticism. The indirect effects are significant on very high levels both for individualism ($A \cdot B_{20}$ = -0.043[***], $A \cdot B_{21}$ = -0.073[***]) and pro-sociality ($A \cdot B_{20}$ = 0.055[***], $A \cdot B_{21}$ = 0.103[***]). The effect of having pro-social values is partially mediated in both samples (proportion 33%, confidence interval: [15%-70%], and 37% [22%-56%]), as the effects complement each other. Having pro-social attitudes is not only associated with higher levels of risk perception, but consistently a lower skepticism level as well, which is also associated with higher levels of risk perception. In the first sample the relationships between individualism and skepticism (β_{20} = 0.263[***]), and skepticism and risk perception were significant (β_{20} = -0.165[***]), therefore we observed a complete mediation of its effect on risk perception (C_{20} = -0.034, $A \cdot B_{20}$ = -0.043[***]). At the time of our second data collection the direct association was also significant between individualistic views and risk perception (C_{21} = 0.084[*]), and it had an opposite direction than the effect through skepticism ($A \cdot B_{21}$ = -0.073[***], resulting a competitive mediation.

These results explain the contradictions noticed comparing the variable importance analyses and the coefficients of the regression models. While individualism in the 2020 sample appeared as the fourth most important variable to predict risk perception, it did not have a significant coefficient in the regression model for risk perception, because its effect was completely mediated by skepticism. On the other hand, the competing direct and indirect effects in the second sample negated its total effect on risk perception (TE_{20} = 0.011) resulting a low relative importance percentage. Competing direct and indirect effects are also present between direct experience and risk perception in both samples ($A \cdot B_{20}$ = 0.158[*], C_{20} = -0.029.; $A \cdot B_{21}$ = 0.243[**], C_{21} = -0.064[*])

Table 18: Antecedents of Risk Perception mediated through Skepticism

		Direct (A·B)	Indirect (C)	Total effect (TE)	Proportion mediated
Individualism	'20-Nov	-0.034	-0.043 ***	-0.077 **	complete mediation
	'21-Sep	0.084 *	-0.073 ***	0.011	competitive mediation
Pro-sociality	'20-Nov	0.111 **	0.055 ***	0.166 ***	partial 33% [15%-70%]
	'21-Sep	0.176 ***	0.103 ***	0.279 ***	partial 37% [22%-56%]
Direct Exp.	'20-Nov	0.158 *	-0.029 .	0.129 .	no mediation
	'21-Sep	0.243 **	-0.064 *	0.179 *	competitive mediation
Indirect Exp.	'20-Nov	0.179 *	0.052 **	0.231 **	partial 22% [6%-75%]
	'21-Sep	0.203 .	-0.058 .	0.144	no mediation
Trust Scientists	'20-Nov	0.077 **	0.019 **	0.096 ***	partial 20% [6%-47%]
	'21-Sep	0.034	0.037 **	0.072 **	complete mediation

Note: The table reports the direct, indirect and total effect sizes between the predictor and the mediator (skepticism), the mediator and the dependent variable (risk perception) and the sum of these effects respectively. The right-hand column classifies the mediating relationship and, in case of partial mediation, gives the estimate and 95% confidence interval of the proportion mediated. Significance levels are denoted with (.) when $p < 0.10$; (*) when $p < 0.05$; (**) when $p < 0.01$; (***) when $p < 0.001$.

which in turn diminished its total effect on risk perception ($TE_{20} = 0.129.$, ($TE_{21} = 0.179^{*}$)), and resulted in a lower relative importance score. The indirect path between

trusting scientists and risk perception is significant in both samples ($A{\cdot}B_{20} = 0.019^{**}$, $A{\cdot}B_{21} = 0.037^{**}$). The association was stronger with risk perception directly in 2020 ($C_{20} = 0.077^{**}$) therefore the effect through skepticism means partial mediation of approximately 20% (c.i.: 6%-47%). In 2021 the direct association diminished ($C_{21} = 0.034$) while the indirect one through skepticism strengthened ($A{\cdot}B_{21} = 0.037^{**}$) resulting a complete mediation. The effect of the indirect experience is also partially mediated by skepticism in the first sample (22% [6%-75%]), but in our September 2021 model its associations with both risk perception and skepticism have diminished ($A{\cdot}B_{21} = 0.203.$, $C_{21} = -0.058.$), as this form of experience had become more common.

6.4. Discussion

Our knowledge on COVID-19 has been constantly increasing which likely has an essential impact on our risk perception. Longitudinal studies around COVID-19 demonstrate that people's general attitude towards the pandemic has been changing throughout the different waves (Marinaci et al. 2021), and their risk perception also varied between different time points (Schneider et al. 2021). In our study we saw the risk perception of young adults slightly decrease from the second to the forth wave in all measured aspects except the seriousness of the sickness. Vaccination has become widely available in 2021, people have become more and more familiar with the virus and over time they are likely to develop 'worry fatigue' (Su et al. 2022). These factors likely contributed to the lessened fear from the virus. We also observed a shift between the two samples regarding which variables are associated with risk perception in our model, but skepticism and pro-sociality proved to be very important predictors in the second and the fourth waves alike. Meanwhile, trust in scientists and the worldviews of the individual were also consistently associated with risk perception indirectly, through skepticism. Our findings suggest that skepticism is an important predictor of risk perception. Hence, in future research complex models trying to explain risk perception around a pandemic should include skepticism related variables.

The strong connection between skepticism and risk perception in the context of the pandemic can show parallels to different risk events like climate change, nuclear power, and vaccine hesitancy. Rutjens, van der Linden and van der Lee (2021) also propose that skepticism about climate change and vaccination exhibit similar characteristics as COVID skepticism, and they might have similar antecedents. In our study we modeled skepticism to serve as a mediator between risk perception and some of its known antecedents. This way the two worldviews we investigated (individualism and pro-sociality) are not only closely associated with COVID skepticism, but also have an indirect effect on risk perception. People with a strong pro-social attitude tend to be less lenient toward a skeptical stance, and also, perceive the risks to be higher, while individualistic worldviews are more prevalent among those with a skeptical stance, which then leads to lowered risk perception. Individualism and pro-sociality were important predictors of COVID related risk perception in the model of Dryhurst et al. (2020) as well. Our study – conducted in an entirely different Hungarian context – also confirms that these two worldviews should not be excluded from any general model explaining COVID related risk perception.

Trust in scientists is strongly associated with COVID skepticism, and through that, risk perception as well. Our findings are in alignment with previous results: Rutjens et al. (2018) found similar negative relationships between faith in science and climate change skepticism and genetically modified food skepticism, Dryhurst et al. (2020) found trust in science to be positively associated with risk perception and **?** found that higher trust in scientists is associated with lower susceptibility to COVID-19 related misinformation. In our study, skepticism was negatively associated with trust in scientists, meaning, those who believe that scientists possess the necessary knowledge related to the coronavirus, are less receptive to skeptical arguments.

We find from the repeated nature of our survey research that the way trust in scientists and government is associated with risk perception is influenced heavily by the discourse at the time of data collection. Dryhurst et al. (2020) similarly claimed that trust in government and low risk perception were only associated in countries

where COVID-19 was more strongly present in the political dialogue. Therefore, it is contextually meaningful, that scientists in Hungary during the second wave conveyed messages emphasizing the unprecedented risk, and greatly increased incident and fatality rates compared to the first wave. In contrast to this, government officials tried to stress the preparedness of the health care system, and the smooth operation of public administration instead, and consequently conveyed more reassuring messages. Therefore it is no surprise, that in our model we observed opposite effects on risk perception from these two variables in our first sample. Yet, in our second sample trust in government was not associated with risk perception anymore, while trust in scientists became a more powerful predictor of skepticism, and was associated with risk perception at that time only through skepticism. The Hungarian government changed its communication tactics in 2021 when choosing a respected professor and rector of the leading medical university to convey its main messages and boost vaccination. So, political and professional communications have often overlapped, which could have caused the previously opposite effects of the trust in these groups to confound and diminish. Perhaps, it is also because of this, that we saw the trust in others emerge as a significant predictor of risk perception in our model in 2021.

During the second wave of COVID-19 in Hungary our results show that female participants perceived COVID-19 related risk higher than males, which was an expected result based on previous findings of risk research, but this gender effect disappeared in our sample one year later. One explanation to this could be the accumulating information about the disease, and that serious consequences of it can be increased by genetic features and could not necessarily be avoided with generally good health. We learned that the actual risk of death from COVID-19 was higher for men (Li et al. 2020), therefore the perceived risks among men could have adjusted accordingly. By the time of the fourth wave the gender effect might have been neutralized by the expanding knowledge on the hazards of COVID-19 and the beliefs that formed around it.

Direct and indirect experience with the disease had different effects on COVID

skepticism. Those who had a family member or a friend contracting the virus perceived higher levels of risk and were less skeptical at the time of the second wave, but this effect disappeared a year later during the fourth wave. One must note, that as the pandemic evolved, almost every member of the society had indirect experience by the time of the fourth wave, hence people started to find it normal to have COVID-19 patients in their close proximity. The commonness of the attribute can explain its diminishing effect in our model. The effects of contracting the disease themselves are more peculiar. Having such a direct experience is associated with increased risk perception and increased skepticism, but we know the latter should come in hand with lower risk perception.

Some of the above findings might be explained by the composition of our sample. Younger adults usually produced only mild symptoms when they were infected, and fatality rates were very low (Bhopal et al. 2021), therefore the relatively insignificant consequences to their health status rather heated their skepticism and their own experience did not serve as a reality check. However, close contacts of the young respondents were more likely older adults, and their presumably more serious negative experiences left a more profound mark on our respondents' perceptions. Risk perception studies often highlight the specific attitudes of young adults towards various risk factors and demonstrate that they frequently underestimate risks. Disparities in risk perception among age groups in the COVID-19 context are even more salient. According to Rosi et al. (2021) young adults perceived less risk in terms of severity, meaning a lower chance to experience serious illness, while older adults considered themselves less vulnerable than younger generations, probably due to fewer contacts maintained and a more cautious lifestyle.

The pioneering longitudinal research of Schneider et al. (2021) called for the attention of risk scholars to examine the stability of correlates over time. The design of our research, meaning its longitudinal nature and that it targeted respondents from the same group, offers an important advantage for this case. As discussed above, several variables maintained their strong association with risk perception (skepticism, pro-

sociality), but others have alternated due to the changing circumstances. The affect of gender diminished, the role of trust in others, the government and scientists depended heavily on the formulated messages and expectations toward them. The direct experience became a better predictor as more people got the disease by the second sample, but indirect experience lost relevance in the model as it got ubiquitous. We should also note, that the composition of our samples mean limitations regarding the generalizability of our findings. Since it doesn't represent a large portion of the population, the relation of the factors might be more compelling than the absolute values of the reported measures.

Our research has other important limitations as well. Notably, due to the survey's timing, the data represents only two points in time during the ever changing course of the pandemic, and the actual dates of data collection (the escalating part of the second wave and fourth waves) define important elements of the context for interpreting our findings. Also, we report the associations among psychological predictors, skepticism and risk perception, but we cannot infer causality. We included variables known to be important antecedents of risk perception, and built our model with skepticism as the mediator, but the set of antecedents to COVID skepticism could probably be extended to build a better model. For example spirituality, political conservatism and scientific literacy were found to be relevant predictors of science skepticism in the comprehensive study of Rutjens, Sengupta, der Lee, van Koningsbruggen, Martens, Rabelo and Sutton (2021). We assumed the worldviews of the individual play an essential role in the belief formation process, which can result a skeptical stance on the hazards of COVID and therefore influence risk perception. Although we have built our model based on findings of previous studies, we emphasize that our results are exploratory and correlational. We modeled the relationships as the worldviews as a predictor of skepticism and that of risk perception, we recognize that causality can happen in both directions. It is also possible that the impact of worldviews on skepticism could be mediated by risk perception, and these relationships should be examined in further research.

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Data availability

All data are publicly available on the Open Science Framework (OSF) website. The repository contains the detailed survey design, all raw data, and the scripts of the analysis (R code) for the presented paper. https://osf.io/rsvy6/

Disclosure statement

No potential conflict of interest was reported by the authors.

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