The role of cognitive and emotional factors in health decision-making

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DOCTORAL THESIS

THE ROLE OF COGNITIVE AND EMOTIONAL FACTORS IN HEALTH DECISION-MAKING

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SPLIT, 2020

Dedication

I fully dedicate this thesis to my mother Vesna Tomljenović, तत्त्वमसि

ACKNOWLEDGEMENTS

My greatest gratitude goes to my supervisor Andreja Bubić, who selflessly guided me for these years, shared her knowledge and experience, who was always available and without whom none of this research would be possible!

I also want to honestly thank professors Damir Sapunar and Livia Puljak for recognizing my motivation to enroll TRIBE and for giving me the opportunity for professional and private development.

Next, I want to thank Darko Hren and Nikola Erceg, for being so cooperative and helpful in our research.

Furthermore, I want to thank my colleagues and friends Blanka Roje, Dario Leskur, Berislav Šporčić, Marijana Matijaš and Ivana Burić who gave me support and counselling in challenging moments.

I also want to mention my closest friends Domagoj, Anita, Suzana, Marija, Lucija, Ljubica and Tamara who were there for me, any day, and any time.

Finally, I especially thank my father Ljubomir and my fiancé Ivica, for their endless love and encouragement.

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LIST OF ABBREVIATIONS

WHO	-	World Health Organization
GP	-	General practitioner
CRT	-	Cognitive Reflection Test
REI	-	Rational-experiential Inventory
NFC	-	Need for Cognition scale
FI	-	Faith in Intuition scale
LOT-R	-	Life Orientation Test Revised
TTA-D	-	Trust Toward Authorities – Disillusionment scale
VHS	-	Vaccine Hesitancy scale
VCB	-	Vaccine Conspiracy Beliefs scale
MFT	-	Moral Foundations Theory
M	-	Mean
Sd	-	Standard deviation
C	-	Median
IQR	-	Interquartile range
Min	-	Minimum
Max	-	Maximum
SE	-	Standard error

1. INTRODUCTION

1.1. Health behavior

Some of the main challenges in modern healthcare concern diseases which are mainly determined by individuals' health behavior. Namely, persons' lifestyles represent the greatest contributors to the development of non-communicable or chronic diseases (1) which are responsible for 71% of causes of death globally (2). Besides contributing to various diseases, from which individuals themselves suffer the most, some health behaviors which they pursue also reflect on different aspects of public health, including under-vaccination as one of the greatest public health threats of today (3). For instance, World Health Organization (WHO) reports indicate that 23,927 individuals were infected with measles in Europe in 2017, which is a fourfold increase compared to the previous year (4). The reports for 2018 are even more alarming, showing that 41,000 individuals were infected in the first six months only (5). Various theoretical models within behavioral epidemiology emphasize that the human factor plays a key role in the drop of vaccination rates, suggesting that programs aimed at disease prevention in which people have a choice are not efficient because they depend on individuals' medical adherence, which is variable (6). In fact, research has shown that characteristics of parents who form negative vaccine-related attitudes and avoid vaccination contribute the most to vaccine hesitancy (7, 8). Therefore, one of the key interests of health psychology today is the understanding of factors which determine whether an individual will behave in a health-promoting way (9). Instances of such factors are judgement and decision-making as cognitive processes which lie at the root of every human choice and accompanying behavior. Although decision-making processes have so far been investigated within less applied fields of psychology, their importance in the medical context is increasingly recognized (10).

1.2. Dual-processing theories in decision-making

Mechanisms which underlie decision-making processes are traditionally investigated within dual-processing theories in cognitive psychology (11). These theories propose two related brain and cognitive systems named simply System 1 and System 2 (11). System 1 is evolutionary older, accounts for most of human behavior and is described as automatic, fast, holistic, intuitive, experience-based, as well as rich in emotions, personalized, social, contextual and heuristic (11). Specifically, Kahneman and Tversky (12) have identified several cognitive shortcuts, that is, heuristics, utilized within this system to make complex decision-making easier. Heuristics work by associating immediate decision-making with preexisting beliefs, for example religious or social norms (13), especially in situations which are uncertain or lack information. On the other hand,

System 2 is evolutionary younger, accounts for a much lesser part of decision-making, and is described as relatively slow, under conscious control, logical, abstract, based on analytical rules, associated with formal learning and intelligence, and more effortful than System 1 (11). It is believed that controlled formal thought processes of System 2 contribute to the decontextualization and depersonalization of decision-making, thus making this system more prepared for dealing with problems present in a modern and technologically advanced society, as well as for scientific reasoning (11). Traditionally, System 2 rules of logic and statistics have been associated to rational reasoning, whereas System 1 heuristics have been associated with error-prone intuitions and irrationality (14).

1.3. Methods for assessing System 1 and 2 reasoning

Within dual-processing theories, researchers have developed methods of assessing individuals' effectiveness in engaging with cognitive processes of System 1 and 2. These are typically assessed by different objective tasks, which include the Heuristics and Biases Tasks (15) and Cognitive Reflection Test (16). Heuristics and Biases Tasks assess different diversions from normative reasoning and are associated with System 1 reasoning. Among others, they include the framing effect, covariation detection, probabilistic reasoning – denominator neglect, causal base rate, the gambler's fallacy, outcome bias problems, and probability matching. The Cognitive Reflection Test is, on the other hand, associated with System 2 reasoning and designed to assess individuals' ability to resist giving incorrect but intuitive answers which they reach if they do not consider the questions carefully (16). In that regard, a substantial body of research has so far systematically demonstrated that individuals' responses on the above-mentioned tasks often diverge from those which are considered normative and rational, therefore displaying information processing biases.

1.4. Individual differences in rationality

Several theoretical perspectives approach the issue of human rationality and explain why the above-mentioned individual differences occur (11). The economic rationality paradigm interprets these errors as unsystematic and random, stating that individuals do not make the same mistake multiple times (11). On the other hand, the bounded rationality approach recognizes substantial internal consistency across these errors (11) and advocates that individuals thereby err in systematic and predictable ways (11). Finally, the youngest, expressive rationality theory recognizes that individuals' reasoning serves important secondary purposes which are not explained by other approaches. Namely, expressive rationality argues that individuals engage in rational processing of information which are conformed with different beliefs their identity is based on (17). Within the bounded rationality approach, Stanovich (11) explains that such systematic differences in rationality are primarily due to inherent computational and cognitive limits, because System 2 reasoning uses

significantly more cognitive capacity than System 1. This is in line with studies which show that cognitive reflection, related to System 2 processing, is substantially correlated with general cognitive ability, or the *g* factor (18). Besides this, Stanovich argues such differences also emerge due to cognitive styles which lead to different tendencies to engage in each of the two systems. Young defines a cognitive style as a trait by which individuals differ, and which affects their cognitive performance and processing in the context of decision-making (19). Among various cognitive styles, one that is closely related to the above-mentioned System 1 and 2 reasoning refers to the willingness or motivation to engage in rational reasoning and behavior related to System 2, and furthermore to deliberately override automatic primary System 1 inputs (20). Specifically, Epstein (20) describes how individuals process information in two parallel channels which interact one with the other. The first one is the intuitive-experiential cognitive style, which is related to System 1 processing and described as automatic, fast, associative, and emotional. The second one is the analytical-rational style, which is related to System 2 processing and described as logical, conscious, mostly free of emotions, and symbolic. Another important distinction is that reasoning imbedded in the rational style changes when presented with new arguments and evidence, while reasoning of the experiential style is not sensitive to argumentation but changes due to repetitive or intense experiences (20). Furthermore, distinctive measures of these styles have been developed. The rational style is measured by the Need for Cognition scale, which represents the individuals' motivation to engage in rational reasoning, deliberate analysis as well as reflexive thinking (19). The experiential style is, on the other hand, measured by the Faith in Intuition scale which refers to automatic and fast information processing based on holistic reasoning or judgements which are not thoroughly thought about, as well as personal or vivid salient information (19). Related to these two cognitive styles is also the maximization style which represents the tendency to optimize the outcomes of a decision, that is, to strive toward making the best possible decisions (21).

1.5. Emotions and optimism in decision-making

Apart from depending on individual's cognitive capacities and cognitive styles, the proneness to reasoning biases and errors is shown to also be associated with the emotional meaning a decision bears for an individual. In this context, emotions play one of the key roles in mediating deviations from rational thinking and decision-making, which is also supported by various pieces of neuroscientific research (22, 23). Specifically, studies have found that people ignore objective probabilities of an event only in emotionally important and not emotionally insignificant scenarios (24). Nevertheless, the role of emotions within the context of health behavior has still not been systematically investigated. Mostly because early research focused on cognitive factors and because the research investigating emotions focused mainly on the role of positive emotionality, that is,

optimism (25). Thereat, it is widely documented that optimism has positive effects on health which are evident at the level of immune and neuroendocrine responses as well (26). Moreover, optimism is associated with a series of beneficial health outcomes and strongly predicts both physical and mental health (27). Apart from that, in the past decade the interest for investigating emotions has been increasing in the context of decision-making as well, and emotions are beginning to take a central place in dual-processing theories, as they are being recognized as an essential part of System 1 reasoning and the intuitive-experiential cognitive style. Specifically, it has been demonstrated that, when an emotionally significant event happens, individuals' response is instantly derived from the intuitive-experiential system, which furthermore automatically searches for related events and their emotional tags in memory (28). To further explain this process, Slovic et al. propose the *affect heuristic* as a shortcut which explains that, during the decision-making process, individuals more or less consciously refer to their emotional pool in which all negative and positive labels are associated with a representation of an event (28). Similarly, Loewenstein proposes the *risk-as-feeling hypothesis* to explain that in situations where System 1 and 2 are in conflict, behavior is more often driven by anticipatory feelings individuals experience during the decision-making process (29). In case when the activated feelings toward an object are positive, both thoughts and behavior are directed toward that object or source of the feelings. Contrary to this, negative or unpleasant feelings motivate avoidance of that source (29). Both the affect heuristic and risk-as-feeling hypotheses explain different behaviors in which cognitive appraisals and emotions diverge and are not concordant.

1.6. Health decision-making

The question of how different cognitive abilities affect individuals' health in modern societies is explored within cognitive epidemiology (30). It proposes that cognitive abilities evolved with the precise purpose of preserving individuals' longevity and reproductive fitness (30). Findings coming from robust and representative cohort studies showed that higher cognitive abilities, generally associated with System 2 processing, greatly contribute to lower mortality rates (30). This association was found for various causes of mortality, such as cardiovascular diseases (31), injuries and accidents (32), as well as dementia (33). Evidently, higher mortality arises from higher rates of diseases, so studies are today focusing on explaining the mechanisms by which cognitive abilities contribute to the development of diseases. Their results indicate that health-promoting behaviors mediate the association of mortality and cognitive abilities (34), such as that people with more proficient cognitive abilities more frequently engage in health-promoting behaviors. Specifically, different studies found higher cognitive abilities to be related to better physical activity and frequent working-out (35, 36), following a healthier diet (37-39) and greater medical adherence (40), to name a few. Moreover, some findings suggest that decisions stemming from System 1 processing can have negative impacts on

health. For example, a study showed that young smokers become addicted by behaving experientially, guided by their emotional processing, that is, enjoying the moment, without fully comprehending the risks and consequences of smoking (28). When these young smokers were asked whether they would start smoking again if given a chance not to, 85% answered they would not. This suggests that their cognitive and emotional appraisals were not concordant and that they behaved in an irrational way. Similar effects of emotional cravings, that is affect heuristic, were also found to be associated with fruit and vegetable consumption, engaging in physical activity, and medical check-ups (25). Nevertheless, despite being associated with irrationality, it has recently been recognized that heuristics related to System 1 reasoning can be useful within uncertain contexts in which at least part of the relevant information is unknown, thus not satisfying the conditions for rational decision theory (14). In these situations, using heuristic strategies that typically include focusing on only a subset of relevant information might make the decision-making process faster and more frugal. Interestingly, in these contexts such simple heuristics can be even more accurate than standard, complex, statistical or rational methods that have the same or more information because having more information becomes more burdensome or useless for the decisionmaker after a certain point (14). Consequently, the so-called ecological rationality approach recognizes the usefulness of heuristic processing, explaining in what degree a heuristic may be considered adaptive with regard to the structure of the decisionmakers' environment (14). This approach may be very applicable to the medical context in which uncertainty is especially pronounced (41). Despite this fact, both medical professionals and patients have problems dealing with uncertainties and show a bias towards determinism in a way that professionals typically look for a cause and not a probability, and patients look for certainty where there is none (42). For example, only more educated patients understand well information presented in intervals, while others find it confusing or unclear (43). That might be the reasons why uncertainty is rarely emphasized in patient-doctor communication, even though medical collaborations like Cochrane or networks of health professionals recommend uncertainty be included in medical information (44).

1.7. Child vaccination as a health decision

Decision-making on vaccination may represent an interesting case in the context of rationality, given that millions of children worldwide do not receive complete basic immunization, despite the scientific consensus that vaccines are both effective and safe (45-47). Among different factors which play a role in such under-vaccination, characteristics of parents as key decision-makers on their children's vaccination are recognized as one of the main contributors to non-adherence (7, 8). Parental decision-making and adherence to child vaccination is identified as very complex and dependent on various factors – cultural, political, religious, as well as cognitive and emotional ones (48-50). Parents

who refuse to vaccinate are found to have various different beliefs and negative attitudes toward vaccination in common (8, 51). First and foremost, vaccine-hesitant parents are characterized by the lack of trust towards vaccination and related institutions, also commonly referred to as *the vaccine backlash, the vaccine-confidence gap* or *crisis of public trust* (52). Secondly, such parents are dissatisfied with the care received from healthcare services (8), which resonates with other findings that show that satisfaction and trust toward the healthcare system have beneficial effects on health behaviors and outcomes (53). Furthermore, a few studies have also found that a portion of vaccine-hesitant parents share beliefs which exceed the boundaries of the lack of trust and dissatisfaction and can be described as conspiracy beliefs (54). For example, they believe pharmaceutical companies and government institutions manipulate immunization data in order to achieve their malevolent – mostly financial – goals (54). Alarmingly, such beliefs might impact public safety since they may negatively affect vaccination rates (54, 55). Another line of research demonstrated that decision-making processes of vaccine-hesitant parents are associated with reasoning biases and errors (56), especially omission bias (57), and that hesitant parents often refer to various emotional cues, anecdotal stories, and vivid experiences of peers (8, 58). These findings may be interpreted in line with the hypothesis that people, during their evolutionary history, developed a higher sensitivity to one kind of threats and a lesser sensitivity to other kinds (29). It is, therefore, possible to suggest parents are evolutionary very sensitive to caring and protecting their offspring and that this tendency represents a very emotionally evoking issue. Because of such emotional significance, parents might be more prone to various deviations from rational thinking which is then reflected on vaccine decision-making. Moreover, another item of research has found that general conspiracy beliefs are related to reasoning biases as well as the intuitive-experiential cognitive style (59). Altogether, these various findings may suggest that vaccine hesitancy, vaccine conspiracy beliefs, and under-vaccination might be a product of irrational reasoning and decision-making.

1.8. Current study

Taking care of one's health can be understood as a complex set of tasks and decisions whose efficacy is greatly associated with cognitive abilities (34). Although a substantial body of research has recognized that reasoning and decision-making processes are related to important real-life decisions (60-62), only a small portion of studies has focused on researching these constructs in the context of health (10). Reasoning biases might be particularly important in this context because individuals more prone to irrational reasoning might more frequently make decisions which have harmful effects on their health and adhere less to medical advice, whereas individuals prone to rational reasoning might more frequently make decisions which are beneficial to their health, and adhere more frequently. Furthermore, interactions between different cognitive and emotional factors are not fully

understood, both generally and in the context of general health decision-making, as well as more specific health contexts such as vaccination. Therefore, the general aim of these studies was to address the role of cognitive and emotional factors in health decision-making, to put it in the context of other well-known factors which contribute to health behavior, and to furthermore provide practical guidelines for vaccination health policies.

2. OBJECTIVES AND HYPOTHESES

The general objective of this study was to explore the relations between different cognitive and emotional factors in making general as well as vaccination-related health decisions. This study consisted of three parts: the first study, which focused on general health decision-making, and two additional studies which focused on the parental decision on child vaccination.

2.1. Objectives

1. The aim was to determine the contribution of cognitive and emotional factors, as well as trust and satisfaction with the health provider, to making decisions in three health behaviors: 1) leading a healthy everyday lifestyle, 2) engagement in healthy behaviors, and 3) medical adherence. The cognitive factors included rationality measures (heuristic thinking and cognitive reflection) and cognitive styles (need for cognition, faith in intuition and maximization). The emotional factors included life-orientation (dispositional optimism vs. pessimism).

2. Building on the first study results, the first aim was to determine the contribution of cognitive and emotional factors to a specific health decision, namely one regarding child vaccination that parents make. The cognitive and emotional factors included in the first study were extended with specific vaccine-related measures. These included trust toward authorities, vaccine hesitancy, emotions toward vaccination and vaccine conspiracy beliefs. The second aim was to explore the interaction effects of rationality regarding the relation between trust toward authorities and vaccine attitudes in three attitude components (the cognitive, affective, and behavioral component).

3. Building on the second study results, the aims were to explore vaccine hesitant parents' decision and non-adherence on child vaccination in more depth, focusing on related perceptions, reasoning and hypothetical situations in which they would reconsider their decision, and to describe different strategies by which they avoid mandatory vaccination.

2.2. Hypotheses

1. More rational, more maximizing, more optimistic individuals and individuals who have more trust in and are more satisfied with their health provider will demonstrate more health behaviors.

2. Firstly, more rational and maximizing, more optimistic individuals and individuals who feel fewer negative emotions toward vaccination will have less strong conspiracy beliefs and will more frequently vaccinate. Secondly, more rational parents and parents who have more trust in authorities will demonstrate more positive vaccine attitudes. Finally, the trust toward authorities will have a moderating effect on the association between rationality and vaccine attitudes.

3. The third study was qualitative and therefore did not have predefined hypotheses.

3. DESIGN AND METHODOLOGY

3.1. Design

The study consisted of three parts:

1. A primary cross-sectional study with data collected from March to November 2017 via pen-paper questionnaires. The participants were undergraduate and graduate students of social sciences and humanities at the University of Split and University of Zadar.

2. A primary cross-sectional study with data collected in April and May 2018 via an online survey shared through social media and internet portals.

3. A primary qualitative study with data collected from September to November 2018 via in-depth interviews conducted by phone or in person. The participants had been recruited by snowball sampling and over social media.

3.2. Outcomes

1. The contribution of cognitive reflection, heuristic thinking, need for cognition, faith in intuition, maximization, life-orientation, and trust in and satisfaction with health provider towards three health behaviors (leading a healthy everyday lifestyle, engagement in healthy behaviors, medical adherence).

2. First, the contribution of need for cognition, faith in intuition, life-orientation, and emotions towards vaccines, to vaccine conspiracy beliefs and uptake. Second, the contribution of cognitive reflection, heuristic thinking and trust toward authorities to vaccine attitudes (the cognitive, affective and behavioral component). Third, the interaction effects of trust toward authorities on the association between cognitive reflection, heuristic and biases, and vaccine attitudes.

3. Review of factors in vaccine-hesitant parents' decision-making on child vaccination, reconsideration and avoidance.

3.3. Methodology

3.3.1. Participants

The results of a pilot study conducted in January and February of 2017 were used to calculate the minimum sample size for the first and second studies. The obtained values of the Pearson correlation coefficient, with the alpha value set at 0.05 and statistical power of 90%, indicated that 170 participants are sufficient for obtaining statistically significant results. The sample size for the third qualitative study could not be determined a priori, and generally no sample size restrictions are

imposed in this type of research since it depends on the specific nature of the phenomenon investigated. However, an examination of relevant literature reveals that for interview studies, including fewer than 12 and more than 50 participants is not recommended (63). Therefore, the sample aimed at 12–50 participants.

The first study consisted of a convenient sample of 186 participants, 175 of whom were female (age 23.0±4.6). Undergraduate and graduate students of social sciences and humanities (majoring in English, Croatian and Italian Language and Literature, Philosophy, History, Pedagogy, Psychology, Teacher and Pre-school Education) of the Universities of Split and Zadar had been approached before class and asked to complete the questionnaires (after giving informed consent to participate) which took around 20–30 min. Apart from agreeing to participate, there were no other inclusion or exclusion criteria.

The second study consisted of a convenient sample of 823 parent participants from Croatia (94% female, age 33.0±6.5). The participants were explained the purpose of the study and gave their informed consent before continuing to the online questionnaire, which lasted for 15–20 minutes. The participants were all those who had previously given their informed consent and chosen to fill out the online survey shared on social media (The parents' info portal www.roda.hr and Facebook). All who did not have one or more children were excluded from the study. There were no other inclusion or exclusion criteria.

The third study consisted of a convenient sample of 25 parent/carer participants (21 female, aged 27–50) with a minimum of one child for whom they had refused one or more mandatory vaccines, or who had altered or intended to alter the immunization schedule and gave informed consent to participate. Parents who accept standard vaccine schedules, people without children and those who refused to participate were excluded from the study. They were recruited by a mixed purposeful sampling strategy according to the described inclusion and exclusion criteria using snowball/ chain sampling. Participants were sent open invitations to participate that were shared on social media and parents' info portal (www.roda.hr).

3.3.2. Procedures and materials

3.3.2.1. STUDY 1: Health decision-making and behavior

The questionnaire is presented in Appendix 1. For the purpose of this study, a General Information Questionnaire was designed to collect participants' demographic information (age, gender and education) and their responses to questions which assessed their health behavior in three

domains. The first question (*Estimate how much you strive toward living healthy in your everyday life [e.g. eating healthy etc.]*) was answered on a 5-point scale (1 – *very much* to 5 – *not at all*) and addressed motivation to keep a healthy everyday lifestyle. The second question (*Estimate how often you behave in ways that are focused toward promoting health [e.g. going to work out, massage etc.])* was answered on a 3-point scale (1 – a few times per year, 2 – a few times per month, 3 – everyday or a few times a week) and addressed additional engagement in health behaviors related to supporting and promoting health. The final question (*Estimate how much you follow advice and recommendation given to you by physicians*) was answered on a 4-point scale (1 – never, 2 – rarely, 3 – sometimes, 4 – always) and addressed the motivation to adhere to recommendation and medical advice given by their physicians.

Heuristics and Biases Tasks (15) included eight tasks which were objectively scored, including the covariation detection, causal base rate, framing problem, probabilistic reasoning – denominator neglect, outcome bias problems, probability matching, gambler's fallacy, and sample size. The scores on these tasks were computed in a single measure, with a higher score indicating lesser proneness to heuristic thinking. Since two tasks (outcome bias and framing problems) consisted of two parts, they were separated in two parts of the questionnaire and their order was counterbalanced through A and B versions of the questionnaire. All the tasks are presented in Appendix 2.

The Cognitive Reflection Test (CRT, 16) is an instrument designed for assessing individuals' ability to resist giving incorrect intuitive answers which the respondents reach if they do not carefully consider the question (e.g. *A bat and a ball cost $1.10 in total. The bat costs $1.00 more than the ball. How much does the ball cost? _____ cents*). The accuracy of each question is objectively scored and the number of correctly answered questions summed in a single measure. A higher score on this scale indicated a greater degree of cognitive reflection. For this study the short 3-item version was used. The reliability of this scale estimated using the Cronbach α was 0.72, and the McDonalds' ω coefficient was 0.73.

The Rational-Experiential Inventory (REI, 20) is a 10-item instrument designed for assessing individuals' preferences for information processing. Theoretically, it is based on the Cognitive-Experiential Self-Theory and distinguishes between two cognitive styles (20). The rational style is measured by an adapted 5-item Need for Cognition Scale (e.g. *I would prefer complex to simple problems*) and emphasizes an analytical and conscious approach. The experiential style is measured by the 5-item Faith in Intuition Scale which emphasizes an affective, pre-conscious and holistic approach (e.g. *My initial impressions of people are almost always right*). The participants assessed how well each of the items describe them on a 5-point rating (1 – not at all to 5 – very much). A higher score indicated a greater Need for Cognition and Faith in Intuition. Reliability estimated using

the Cronbach α coefficient for NFC was 0.69, and 0.85 for FI, and the McDonalds' ω coefficient was 0.71 for NFC and 0.86 for FI.

Short Maximizing Scale (21) is a 6-item instrument designed for measuring individuals' desire to make the best possible decisions or tendency to maximize (e.g. *No matter what I do, I have the highest standards for myself*). The participants assessed how much they agree with each of the items on a 7-point scale (1– completely disagree to 7 – completely agree). A higher score reflected higher maximizing tendencies. Reliability of this scale estimated using the Cronbach α was 0.67, and the McDonalds' ω coefficient was 0.68.

Life Orientation Scale Revised (LOT-R, 64) is a standardized 10-item instrument designed to assess dispositional optimism. Three items of the instrument measure optimism (e.g. *In uncertain times, I usually expect the best),* 3 items measure pessimism (e.g. *If something can go wrong for me, it will*) and are reversely scored, while 4 items which are not scored serve as fillers. Respondents rated each item on a 5-point scale (1 – strongly disagree to 5 – strongly agree). A higher score indicated higher dispositional optimism. Reliability of this scale estimated using the Cronbach α was 0.80, and the McDonalds' ω coefficient was 0.81.

The Trust and Satisfaction with Health Provider Scale was designed for this study and consisted of three questions. The questions measured overall satisfaction with health care provided by the general practitioner (GP), overall satisfaction with health care provided by other physicians, and overall trust in the health care system. The participants rated how much they agree with each of the items (e.g. *Estimate how satisfied you are with the healthcare provided to you by your GP*) using a 5- point scale (1 – not at all to 5 – very much). A higher score reflected higher trust in and satisfaction with the health provider. As this scale was newly designed and not previously used in research, a principal component factor analysis was conducted, which revealed one extracted component explaining a total of 65% of the variance. Reliability of this scale estimated using the Cronbach α was 0.72, and the McDonalds' ω coefficient was 0.73.

3.3.2.2. STUDY 2: Vaccine conspiracy beliefs and attitudes

The questionnaire is presented in Appendix 3. A General Information Survey was designed to collect participants' demographic information (age, gender, education, profession, marital status, number of children), along with a question on vaccination behavior which addressed their real-life vaccination decisions. In this question, participants were asked whether they had fully vaccinated, partially vaccinated, or not vaccinated their children at all (*If you have children, have they been vaccinated so far?* answered in the following scale: *a) they received all mandatory vaccinations, b) they received some but not all mandatory vaccinations, c) they received none of the mandatory*

vaccinations, d) I have no children). This question served as an indicator of vaccine uptake and the behavioral component of vaccine attitudes, as well as for excluding participants without children.

The Cognitive Reflection Test (16) is described in section 3.3.2.1., with the difference that in this study the 6-item version was used. Reliability of this scale estimated using both the Cronbach α and the McDonalds' ω coefficient was 0.75.

Heuristics and Biases Tasks (15) are described in section 3.3.2.1., and Appendix 2. In this study the causal base rate, outcome bias, and omission bias tasks were included.

The Rational-Experiential Inventory (20) is described in section 3.3.2.1. Reliability of this scale estimated using the Cronbach α coefficient was 0.62 for NFC and 0.92 for FI, and the McDonalds' ω was 0.66 for NFC and 0.92 for FI.

Life Orientation Scale Revised (64) is described in section 3.3.2.1. In this study, filler items were not included. Reliability of this scale estimated using the Cronbach α was 0.74, and the McDonalds' ω coefficient was 0.75.

Trust Toward Authorities – Disillusionment Scale (TTA-D, 54) is a standardized 6-item instrument designed to assess disillusionment with authorities involved in vaccination (e.g. *I feel tricked, cheated or deceived by those who are involved in immunizations [e.g. the government, pharmaceutical companies, etc.]*). Respondents rated each item using a 6-point scale (1 – strongly disagree to 6 – strongly agree). A higher score indicated higher trust, that is, lower disillusionment with authorities. Reliability of this scale estimated using the Cronbach α was 0.92, and the McDonalds' ω coefficient was 0.93.

Emotions Toward Vaccination Scale was designed for the purpose of this study to assess a range of both unpleasant and pleasant emotional states (anger, fear, relaxation, disgust, anxiety, repulsiveness, worry, calmness). The participants rated how strongly they feel each of the listed emotions when thinking about vaccinating their child using a 5-point scale (1 – very little to 5 – very much). All pleasant emotions were reversely scored and a sum score computed such that higher values represented more unpleasant emotions toward vaccination. This scale served as the affective component of vaccine attitudes. Given that this scale was newly designed and not used before, a principal component factor analysis was conducted, which revealed one extracted component explaining a total of 64% of the variance. Reliability of this scale estimated using both the Cronbach α and the McDonalds' ω coefficient was 0.92.

Vaccine Hesitancy Scale (VHS, 65) represents a standardized 9-item measure of hesitancy toward child vaccination (e.g. *I am concerned about serious adverse effects of vaccines*). Respondents

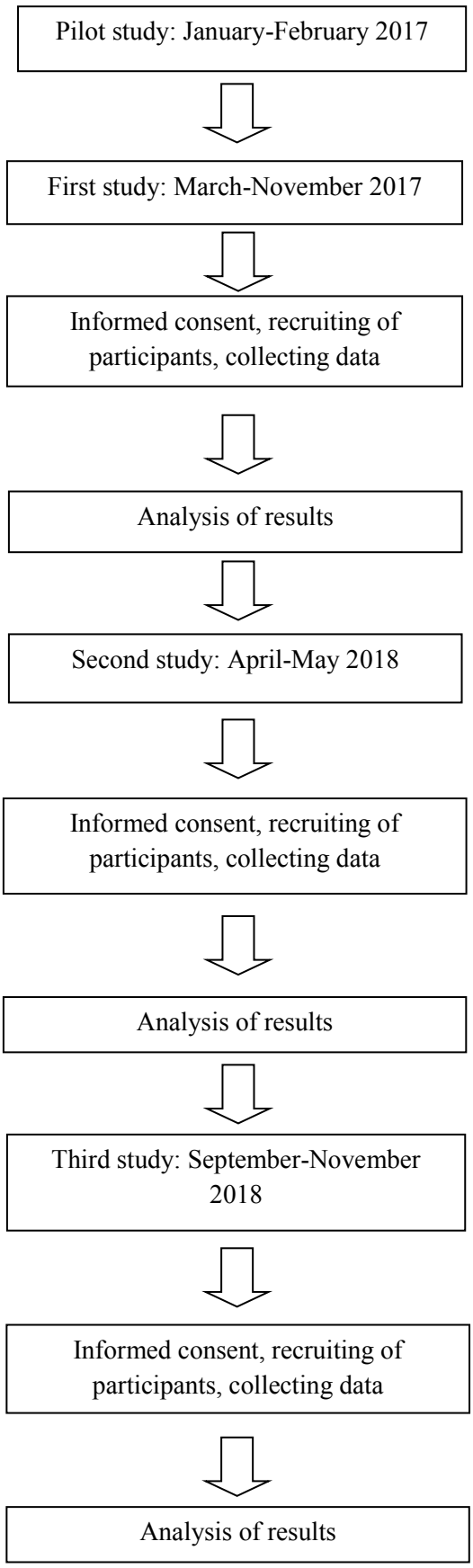
rated each item using a 5-point scale (1 – strongly disagree to 5 – strongly agree). A higher score indicated higher vaccination hesitancy. This scale served as a measure of the cognitive component of vaccine attitudes. Reliability of this scale estimated using both the Cronbach α and the McDonalds' ω coefficient was 0.94.

Vaccine Conspiracy Beliefs Scale (VCB, 66) is a standardized 7-item instrument designed to assess immunization-related conspiracy beliefs (e.g. *Pharmaceutical companies cover up the dangers of vaccines*). Respondents rated each item using a 7-point scale (1 – strongly disagree to 7 – strongly agree), a higher score indicated higher vaccine conspiracy beliefs. Reliability of this scale estimated using both the Cronbach α and the McDonalds' ω coefficient was 0.98.

3.3.2.3. STUDY 3: Decision-making underlying child vaccination avoidance

Participants were given an informed consent sheet and explained their rights and the purpose of the study, as well as the basic rules of participation. After completing the socio-demographic questionnaire, the participants were interviewed following a topic guide. The socio-demographic questionnaire (Appendix 4) was designed to collect basic information (gender, age, education, level, marital, employment status, political and religious orientation), and information regarding their children's' vaccination, including the list of vaccination their children had received, and which they refused or delayed. Also, they were asked to report whether a vaccine-preventable epidemic had occurred in their living area within the past 5 years. The topic guide (Appendix 5) was following the principle of basing the enquiry in human experience (67). It was the first pilot tested on two participants and refined where necessary. All the interviews were held in a controlled setting between the participant and interviewer, who was trained in basic qualitative research methodology and supervised by a senior researcher. They were conducted in person or by phone, in cases when it was more convenient for the participants. The interviews were audio-recorded using a recording device or a phone-call recorder and transcribed by voice recognition software (Google speech-to-text). All the verbatim transcripts were double-checked and corrected in relation to audio recordings. The interviewer took notes related to her reflections and content immediately after the interviews. The transcripts were securely stored and only the PhD candidate had access to them and the codes that enabled connecting a specific transcript to participant's identity. The audio files were deleted upon transcription.

3.3.3. Study flow diagram



3.3.4. Statistical and qualitative data analyses

The participants' socio-demographic data in all three studies was collected on nominal, ordinal, interval, and scale measures (age, gender, education, level, marital, employment status, political and religious orientation, number of children, children's vaccination uptake). All the data from the first and second study – regarding cognitive and emotional factors and vaccine specific measures – were measured on a scale, representing the scores each participant obtained on these instruments. The data obtained from the first and second study was entered into a spreadsheet and prepared for analysis in Statistica. In the first study, normality of data distribution was checked using the Kolmogorov–Smirnov test and skewness and kurtosis indices. Furthermore, Pearson and Spearman correlation coefficients were used to calculate the correlations between the tested variables. Descriptive data was shown as mean and standard deviation, as well as median and range. In the second study, the normality of data distribution was checked using the Kolmogorov–Smirnov test and descriptive data was shown as mean and standard deviation. Pearson correlation coefficient was used to calculate the correlations between the tested variables. In the first and second study, the reliability of the used instruments was calculated using the Cronbach alpha (α) and McDonalds' omega (ω) coefficients. Furthermore, in both studies, the contribution of cognitive and emotional factors to health behaviors, vaccine attitudes, conspiracy beliefs and vaccination uptake was calculated by hierarchical regression analyses. In the first study, predictors in the analyses included heuristic and biases tasks, cognitive reflection test, need for cognition, faith in intuition, maximization, life-orientation, trust in and satisfaction with health provider; whereas the criteria included leading a healthy everyday lifestyle, engagement in healthy behaviors, and medical adherence. In the second study, predictors in the analyses included gender, age, education level, political orientation, heuristic and biases tasks, cognitive reflection test, need for cognition, faith in intuition, maximization, life-orientation, and trust toward authorities. The criteria included vaccine conspiracy beliefs, vaccine uptake, and vaccine hesitancy, whereas emotions toward vaccines was used both as a predictor and as criteria, depending on which of the hypothesis was being tested. In all the analyses the significance level was set at $P<0.05$. The trust in and satisfaction with health provider and emotions toward vaccination scales which were designed for the first study were analyzed with a principal component factor analysis, given that they were not previously used in research.

In the third study, the data was qualitative and consisted of transcripts of the raw audio data. The obtained data was analyzed using the Thematic analysis framework (68). It included developing an initial coding framework based on preliminary analysis of the first six interviews. The preliminary analysis was done under the supervision of a senior researcher. This framework was then applied to code the remaining data. After that, the codebook (Appendix 6) was redefined. During this stage, the

codebook was reviewed and refined multiple times where necessary and when the final codebook was developed, the final codes were assigned to all upcoming transcripts. The data was then entered into a program specialized for qualitative data analysis, Atlas.ti. As reporting guidelines, The Standards for Reporting Qualitative Research (69) were referred to.

3.3.5. Ethical principles

Ethics approval for all the three studies was obtained from the ethics committee of the School of Medicine, University of Split, with the following ID numbers: (1) 2182-198-01-04-17-0053, (2) 2181-198-03-04-18-0019 and (3) 2181-198-03-04-18-0048. All the data was collected with respect to ethical standards according to the Helsinki declaration and good clinical practice guidelines. All the participants were given codes which assured their identity stayed anonymous and their data protected. All the participants were informed about the purposes of the studies, as well as their rights and were asked to give informed consent when entering the study.

4. RESULTS

4.1 STUDY 1: Health decision-making and behavior

This study included 186 student participants and focused on general health decision-making; the descriptive statistics of the administered instruments are shown in **Table 1**.

Table 1. Descriptive statistics of the administered instruments

Measure	*M*±*Sd*	*Min*	*Max*
Healthy everyday lifestyle	3.23±0.88	1	5
Healthy behaviors	1.82±0.83	1	3
Medical adherence	3.48±0.59	2	4
Heuristics and Biases Tasks	3.58±1.69	0	7
Cognitive reflection	1.40±1.19	0	3
Need for cognition	15.68±3.38	6	25
Faith in intuition	18.73±3.72	5	25
Maximizing	25.68±6.36	10	41
Optimism	21.49±4.29	9	30
Trust in and satisfaction with health provider	10.77±2.08	4	15

As a first step in analyzing the relations between cognitive and emotional factors with health behaviors, correlation analyses were conducted (**Table 2**). Positive correlations were found between leading a healthy everyday lifestyle and maximizing, optimism, and trust in and satisfaction with the health provider. Next, engagement in healthy behaviors correlated positively with heuristic thinking, maximizing, and optimism. Furthermore, a strong positive correlation between leading a healthy everyday lifestyle and engaging in healthy behaviors was found. Finally, medical adherence was positively correlated to trust in and satisfaction with the health provider.

Table 2. Correlation matrix of the tested variables

Measure	2	3	4	5	6	7	8	9	10
Heuristic thinking (1)	0.40**	0.14	-0.15*	-0.00	-0.02	-0.16*	-0.09	-0.17*	-0.07
Cognitive reflection (2)		0.18*	-0.14	-0.03	-0.15*	-0.03	-0.10	-0.08	0.02
Need for cognition (3)			-0.00	-0.01	0.06	0.04	0.11	0.00	0.13
Faith in intuition (4)				-0.04	0.18*	0.07	0.04	-0.11	-0.04
Maximizing (5)					-0.12	-0.09	0.21*	0.15*	-0.12
Optimism (6)						0.06	0.18*	0.17*	-0.01
Trust in and satisfaction with health provider (7)							0.16*	-0.04	0.37**
Healthy everyday lifestyle (8)								0.61**	0.01
Healthy behaviors (9)									-0.12
Medical adherence (10)									

Note: *P<0.05; **P<0.01.

Hierarchical regression analyses were next performed in order to determine the contributions of heuristic thinking, cognitive reflection, need for cognition, faith in intuition, optimism, and trust in and satisfaction with the healthcare provider to health behaviors (**Table 3**).

Table 3. Results of the hierarchical regression analysis using Healthy everyday lifestyle, Healthy behaviors and Medical adherence as criteria

			Criteria				
		Predictors	Healthy everyday lifestyle	Healthy behaviors	Medical adherence	Tol.	VIF
Step 1	β	Heuristic thinking	-0.09	-0.17*	-0.13	0.83	1.20
		Cognitive reflection	-0.07	-0.03	0.03	0.81	1.24
		Need for cognition	0.14	0.05	0.17*	0.96	1.04
		Faith in intuition	0.03	-0.09	-0.05	0.97	1.04
		Maximizing	0.19*	0.15*	-0.12	0.99	1.01
	R		0.26	0.24	0.24		
	R^2		0.07	0.06	0.06		
	F (df=5)		2.64*	2.24	2.20		
Step 2	β	Heuristic thinking	-0.09	-0.17*	-0.13	0.83	1.20
		Cognitive reflection	-0.04	0.01	0.03	0.79	1.27
		Need for cognition	0.13	-0.03	0.17*	0.96	1.05
		Faith in intuition	0.02	-0.11	-0.05	0.95	1.05
		Maximizing	0.21**	0.17*	-0.12	0.98	1.02
		Optimism	0.17*	0.20**	-0.01	0.94	1.07
	R		0.31	0.31	0.24		

	R^2		0.09	0.09	0.06		
	ΔR^2		0.03*	0.04**	0.00		
	F (df=6)		3.12**	3.19**	1.83		
Step 3	β	Heuristic thinking	-0.07	-0.18*	-0.07	0.81	1.23
		Cognitive reflection	-0.04	0.01	-0.02	0.78	1.28
		Need for cognition	0.12	0.04	0.14*	0.95	1.05
		Faith in intuition	0.01	-0.11	-0.08	0.95	1.05
		Maximizing	0.23**	0.17*	-0.08	0.97	1.03
		Optimism	0.15*	0.21**	-0.03	0.93	1.07
		Trust and satisfaction with health provider	0.16*	-0.03	0.35**	0.94	1.06
	R		0.35	0.31	0.42		
	R^2		0.12	0.01	0.17		
	ΔR^2		0.02*	0.00	0.15**		
	F (df=7)		3.44**	2.76*	5.32**		

Note: *P<0.05; **P<0.01; β - standardized regression coefficient; *R* - multiple regression coefficient; R^2 - variance explained by the predictors; ΔR^2 - change in R^2; *F* - F ratio; *df* - degrees of freedom; Tol. - tolerance; VIF - collinearity statistics

4.1.1. Leading a healthy everyday lifestyle

Heuristic thinking, cognitive reflection, need for cognition, faith in intuition and maximizing were entered as predictors in the first step, optimism in the second step, and trust in and satisfaction with the healthcare provider in the final step of the analysis. Maximization was identified as the only significant predictor in the first step and remained significant after accounting for other predictors. In the next steps, optimism and trust in and satisfaction with the healthcare provider were also identified as significant (**Table 3**).

4.1.2. Engagement in healthy behaviors

The second regression analysis followed the same steps and predictors as the previous one. Similar to leading a healthy lifestyle, maximization was identified as a significant predictor in the first step and remained significant in the later steps. Furthermore, heuristic thinking and optimism were significant in the second step and no other significant predictors emerged (**Table 3**).

4.1.3. Medical adherence

In the final analysis, need for cognition was identified as a significant predictor in the first step and remained significant after adding other predictors. No significant predictors emerged in the second step. In the final step, only trust in and satisfaction with healthcare provider was identified as a significant predictor (**Table 3**).

4.2. STUDY 2: Vaccine conspiracy beliefs and attitudes

Most of the 823 participants were married or in a relationship (95%), and fewer than 5% were single, divorced or widowed. As for political ideology, most of the participants identified themselves as moderately or slightly left oriented (66%), whereas 14% were extremely left oriented, 13% slightly right oriented, 6% moderately right, and 2% extremely right oriented. In this sample, 51% had one child, 35% had two, 10% had three children and fewer than 3% had four or more children. Regarding vaccination uptake, 66% of the parents stated their children received all scheduled mandatory vaccination, 23% received some but not all mandatory scheduled vaccination, and 4% did not receive any vaccination at all.

4.2.1. Vaccine conspiracy beliefs and uptake

When comparing the vaccine conspiracy beliefs in this sample to Shapiro and colleagues (66), 172 participants or 21% obtained a score of +1 *Sd* and 84 participants or 10% a score of +2 *Sd*, and these participants therefore demonstrate strong vaccine conspiracy beliefs. Other descriptive information is presented in **Table 4**.

Table 4. Descriptive statistics of the administered instruments

Measure	*M*±*Sd*	*Min*	*Max*
Age	33±6.45	20	71
Education	3.30±0.88	1	4
Political ideology	2.64±1.12	1	6
Vaccine uptake	1.33±0.56	1	3
Vaccine conspiracy beliefs	20.33±13.67	7	49
Need for cognition	18.96±3.64	5	25
Faith in intuition	17.80±4.92	5	25
Emotions toward vaccination	21.01±8.54	8	40
Optimism	22.87±4.40	6	30

Note: *M* – mean; *Sd* – standard deviation; *Min* – minimum; *Max* – Maximum.

Next, a correlation analysis was conducted (**Table 5**) in order to explore the relations between vaccine conspiracy beliefs and vaccine uptake to various predictors (age, education, marital status, political ideology, need for cognition, faith in intuition, emotions toward vaccination, and optimism). A strong positive correlation between higher conspiracy beliefs and lesser vaccine uptake was identified. Next, both criteria correlated with stronger unpleasant emotions toward vaccination. Stronger conspiracy beliefs correlated with lower education, a more conservative political ideology, and higher faith in intuition.

Table 5. Correlation matrix of the tested variables

	2	3	4	5	6	7	8	9	10
Education (1)	0.21**	-0.02	-0.03	-0.02	-0.16**	0.20**	-0.13**	-0.08*	0.09**
Age (2)		0.07*	-0.15**	-0.01	-0.02	0.11**	-0.13**	-0.02	0.02
Marital status (3)			-0.14**	0.04	0.01	0.00	-0.14**	-0.05	-0.08*
Political ideology (4)				0.03	0.10**	-0.17**	0.09**	0.11**	0.00
Vaccine uptake (5)					0.60**	0.01	0.00	0.52**	0.03
Vaccine conspiracy beliefs (6)						-0.06	0.20**	0.76**	0.04
Need for cognition (7)							0.03	-0.07	0.18**
Faith in intuition (8)								0.15**	0.20**
Emotions toward vaccination (9)									0.02
Optimism (10)									

Note: * - P<0.05; ** - P<0.01.

Finally, two hierarchical regression analyses were conducted to determine the exact contribution of the abovementioned predictors to conspiracy beliefs and vaccination uptake (**Table 6**). In the first step, no significant predictors of vaccination uptake emerged, whereas conspiracy beliefs were predicted by lower education and a more conservative political ideology. In the second step, apart from education and political ideology, faith in intuition was also identified as a significant predictor of conspiracy beliefs, and still no significant predictors of uptake emerged. In the third step,

the contribution of political ideology to conspiracy beliefs was no longer significant, whereas education and faith in intuition remained significant. In this step, faith in intuition was identified as a significant predictor of vaccination uptake, and higher unpleasant emotions toward vaccination were also identified as significant in predicting both conspiracy beliefs and uptake. A contradictory result is that faith in intuition was identified as positively contributing to conspiracy beliefs but negatively to vaccination uptake. In order to investigate this finding in more detail, the participants were split into three groups based on their emotions toward vaccination: low, moderate, and high. The correlation between faith in intuition and vaccination uptake was then compared between these three groups, and it was found to be significant only in the low emotions toward vaccination group (r=-0.18, P<0.00). This finding indicates that parents, who had fewer unpleasant emotions toward vaccination and higher trust in their intuition, vaccinate more often. This interaction was not found in parents who had moderate or high negative emotions toward vaccination.

Table 6. Results of hierarchical regression analyses using Vaccine Conspiracy Beliefs and Vaccination Uptake as criteria

			Criteria			
			Vaccine Conspiracy	Vaccination	Tol.	VIF
		Predictors	Beliefs	Uptake		
Step 1	β	Gender	-0.06	0.02	0.96	1.04
		Age	0.04	-0.01	0.91	1.10
		Education	-0.15**	-0.01	0.96	1.05
		Political ideology	0.11**	0.04	0.97	1.03
	R		0.19	0.05		
	R^2		0.04	0.00		
	F (df=4)		8.75**	0.51		
Step 2	β	Gender	-0.05	0.02	0.95	1.06
		Age	0.06	-0.01	0.91	1.11
		Education	-0.13**	-0.02	0.91	1.10
		Political ideology	0.10**	0.04	0.93	1.01
		Faith in intuition	0.18**	-0.01	0.96	1.05
		Need for cognition	-0.02	0.01	0.92	1.10
	R		0.27	0.05		
	R^2		0.07	0.00		

	ΔR^2		0.03**	0.00		
	F		10.90**	0.37		
	(df=6)					
Step 3	β	Gender	0.02	0.05	0.94	1.07
		Age	0.03	-0.01	0.90	1.11
		Education	-0.09**	0.01	0.90	1.11
		Political ideology	0.02	-0.01	0.92	1.10
		Faith in intuition	0.08**	-0.08*	0.90	1.11
		Need for cognition	-0.00	0.02	0.89	1.13
		Optimism	0.01	0.03	0.93	1.08
		Emotions	0.74**	0.53**	0.95	1.05
	R		0.77	0.52		
	R^2		0.59	0.26		
	ΔR^2		0.52**	0.28**		
	F		155.47**	37.51**		
	(df=8)					

Note: *P<0.05; **P<0.01; β - standardized regression coefficient; *R* - multiple regression coefficient; R^2 - variance explained by the predictors; ΔR^2 - change in R^2; *F* - F ratio; *df* - degrees of freedom; Tol. - tolerance; VIF - collinearity statistics

4.2.2. Vaccine attitudes and trust toward authorities

Descriptive information on the instruments is presented in **Table 7**.

Table 7. Descriptive statistics of the administered instruments

Measure	*M*±*Sd*	*Min*	*Max*
Emotions toward vaccination	21.01±8.54	8	40
Vaccine hesitancy	23.69±10.55	9	45
Cognitive reflection, CRT	3.71±1.81	0	6
Heuristic thinking	1.43±0.91	0	3
Trust toward authorities, TTA-D	18.14±8.75	6	36

Note: *M* – mean; *Sd* – standard deviation; *Min* – minimum; *Max* – Maximum.

As the first step in exploring the relationship between the criteria (affective, cognitive and behavioral attitude component) and predictor variables (cognitive reflection, heuristic thinking, disillusionment with authorities), a correlation analysis was conducted (**Table 8**). As expected, strong positive correlations between the criterion variables emerged. All the criteria were also negatively correlated with heuristic thinking and trust toward authorities. Next, the affective and cognitive components were negatively correlated with cognitive reflection. Trust toward authorities was also correlated with cognitive reflection and heuristic thinking.

Table 8. Correlation matrix of the tested variables

	2	3	4	5	6
Vaccine affect (1)	0.74**	0.52**	-0.08**	-0.30**	-0.73**
Vaccine cognition (2)		0.70**	-0.16**	-0.34**	-0.82**
Vaccine behavior (3)			-0.04	-0.23**	-0.58**
Cognitive reflection, CRT (4)				0.26**	0.17**
Heuristic thinking (5)					0.34**
Trust toward authorities, TTA-D (6)					

Note: *P<0.05; **P<0.01

Next, hierarchical regression analyses were conducted to test the hypotheses concerning the contribution of rationality to three vaccine-attitude components. The first regression analysis included cognitive reflection as the first measure of rational thinking and disillusionment with authorities in the first step, and the interaction between these variables in the second step (**Table 9**). Disillusionment with authorities was identified as the only significant predictor of all criteria, and no interaction effect emerged.

Table 9. Results of hierarchical regression analyses using Vaccine Affect, Cognition and Behavior as criteria

			Criteria				
		Predictors	Affect	Cognition	Behavior	Tol.	VIF
Step 1	β	TTA-D	-0.74**	-0.82**	-0.58**	0.97	1.03
		CRT	0.03	-0.02	0.05	0.97	1.03
	R		0.74	0.82	0.58		
	R^2		0.54	0.67	0.33		
	F (df=2)		522.24**	916.49**	205.01**		
Step 2	β	TTA-D	-0.74**	-0.82**	-0.58**	0.97	1.03
		CRT	0.04	-0.02	0.05	0.97	1.03
		TTA-D*CRT	-0.01	0.00	0.00	0.99	1.00
	R		0.74	0.82	0.58		
	R^2		0.54	0.67	0.33		
	ΔR^2		0.00	0.00	0.00		
	F (df=3)		347.80	610.32**	136.56**		

Note: *P<0.05; **P<0.01; β - standardized regression coefficient; *R* - multiple regression coefficient; R^2 - variance explained by the predictors; ΔR^2 - change in R^2; *F* - F ratio; *df* - degrees of freedom; Tol. - tolerance; VIF - collinearity statistics

The second regression analysis was conducted equivalently as the first, with heuristic thinking as the second measure of rationality (**Table 10**). Again, disillusionment with authorities was identified as a significant predictor of all criteria. Next, heuristic thinking was identified as a significant predictor of the affective and cognitive component of vaccine attitudes. Finally, a significant

interaction effect of disillusionment with authorities and heuristic thinking emerged for the cognitive and behavioral component, but not the affective component.

Table 10. Results of hierarchical regression analyses using Vaccine Affect, Cognition and Behavior as criteria

			Criteria				
			Affect	Cognition	Behavior	Tol.	VIF
		Predictors					
Step 1	β	TTA-D	-0.71**	-0.79**	-0.56**	0.89	1.13
		Heuristic thinking	-0.06**	-0.07**	-0.04	0.89	1.13
	R		0.74	0.82	0.58		
	R^2		0.54	0.68	0.33		
	F (df=2)		526.86	934.79**	204.12**		
Step 2	β	TTA-D	-0.71**	-0.79**	-0.55**	0.87	1.15
		Heuristic thinking	-0.07**	-0.08**	-0.06	0.86	1.16
		TTA-D*Heuristic thinking	0.02	0.04*	0.08**	0.96	1.04
	R		0.74	0.83	0.58		
	R^2		0.54	0.68	0.34		
	ΔR^2		0.00	0.01*	0.01**		
	F (df=3)		351.13**	627.86**	139.32**		

Note: *P<0.05; **P<0.01; β - standardized regression coefficient; *R* - multiple regression coefficient; R^2 - variance explained by the predictors; ΔR^2 - change in R^2; *F* - F ratio; *df* - degrees of freedom; Tol. - tolerance; VIF - collinearity statistics

To investigate the emerged interactions in more detail, the participants were split into two groups – low and high in disillusionment with authorities. The variable median was used as a cut-off point, and disillusionment, overriding heuristic thinking, and the criteria were plotted as shown in Figures 1 and 2. The interaction indicates that parents with low disillusionment have positive attitudes, regardless of their ability of correct reasoning. On the other hand, for parents with high disillusionment, the cognitive and behavioral components depend on their ability to correctly reason in heuristics and biases tasks in a way which suggests that the more rational parents are, the more likely they are to have more positive beliefs in vaccines and vaccinating more regularly.

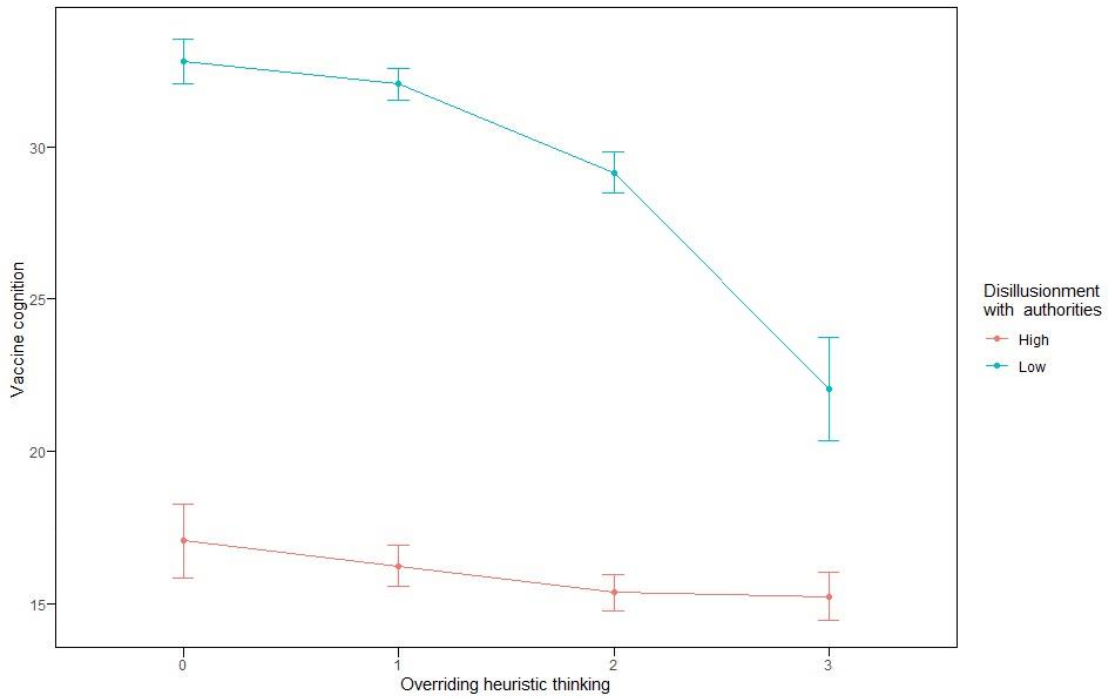


Figure 1. Interaction of disillusionment with authorities (TTA-D) and heuristic thinking in vaccine cognition

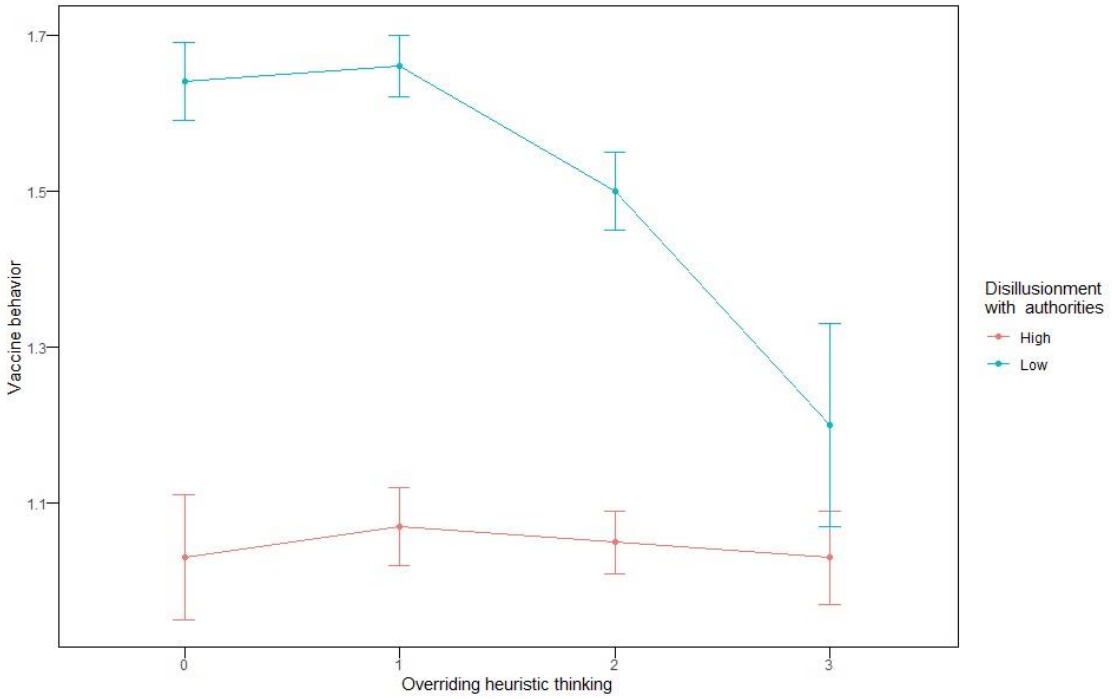


Figure 2. Interaction of disillusionment with authorities (TTA-D) and heuristic thinking in vaccine behavior

4.3. STUDY 3: Decision-making underlying avoidance of child vaccination

Socio-demographic information on the participants is presented in **Table 11**. Notable variations among the participant's children's vaccination uptakes were found. For instance, the youngest child received no vaccination thus far, and the oldest child received all or some vaccinations. Three participants stated they avoided all mandatory vaccination for their children, while children of six participants received only the first vaccine and none other.

Table 11. Socio-demographic information

		N
Level of education	High school	6
	University	19
Socio-economic status	Below-average	2
	Average	20
	Above-average	3
Employment status	Employed	22
	Unemployed	1
	Parental leave	2
Marital status	Married	21
	In a relationship	2
	Divorced	1
	Single	1
Number of children	One	11
	Two	9

	Three or more	4
Political orientation	None	16
	Centre	4
	Left	3
	Anarchist	2
Religious views	Christian-catholic	15
	Other	3
	None	7
Experience with epidemic of infectious diseases	No	22
	Yes (measles and whooping cough)	3

During the analysis, various categories were found and divided into broader-related themes. All themes and categories, along with subcategories and number of participants who addressed each theme are presented in **Table 12**. The emerged themes included decision-making on vaccination and hesitancy, reflection on the decision, avoidance behavior, dealing with the outcome and reconsidering vaccinating. The themes are presented with relevant participants' quotations, marked by participants' IDs and starting line of quote in transcript.

Table 12. Identified themes and their frequency

Theme 1. Decision-making on vaccination and hesitancy		
Category	**Subcategory**	**Frequency**
Complexity	/	4
Emotional and intuitive factors	/	15
Impact of social connections	Case reports	9

	Social support	8
Information search process	/	15
Different stages of the process	/	12
Theme 2. Reflection on the decision		
Category	**Subcategory**	**Frequency**
Justification by general beliefs	Worldview	5
	Moral beliefs	13
	Religious	1
	Responsibility and parental role	14
Health-related beliefs	Alternative medicine	12
	Health today	15
	Immunity	8
	Diseases	10
Vaccine-specific beliefs	Mistrust toward scientific studies	5
	Valence	15
	Ways of Vaccinating	12
	Conducting of vaccine procedures	7
	Generalization	13
	Other countries	10
	Components	13
	Risk	6

	Quality	9
	Herd immunity	9
	Impact on body	6
	Conspiracy beliefs	15
Side-effects	Registration and tracking	13
	Denial from healthcare professionals	14
	Experience	10
Communication issues	Lack of information giving and argumentation	10
	Unprofessional communication	9
	Importance of communication	2
Criticizing healthcare professionals	Lack of expertise	7
	Negative experience with healthcare	11
	Physicians against vaccinating	9
Child's best interest	Individuality	2
	Health status	5
	Sensitivity	3
Social comparison	Polarization of attitudes	8
	Differences in declared parental attitudes	7

Theme 3. Avoidance behavior		
Category	**Subcategory**	**Frequency**
Straightforward rejection	/	6
Rejection justified by child's (un)related health issues	/	3
Obtaining official medical documentation	/	3
Cooperation with physician	/	7
Consequences	/	6
Malingering	/	3
Disappearing in the system	/	4
Stalling in the hope the issue will disappear	/	4
Emigration	/	2
Not having more children	/	1
Theme 5. Dealing with the outcome		
Category	**Subcategory**	**Frequency**
Not considering the outcome	/	3
Denying risk	/	2
Relying on curative modern medicine	/	3
Relying on the body's natural immune system and milder forms of the disease	/	10

Better health in non-vaccinated children	/	5
Emotional coping (guilt and omission bias)	/	4
Theme 5. Reconsidering vaccinating		
Not reconsidering the option	/	7
Would reconsider if safety was assured	/	2
Would reconsider if benefits were clearly presented	/	2
Would reconsider if alternative vaccines were available	/	3
Not sure about reconsidering the option	/	2
Would reconsider for specific vaccines	Travelling to distant areas	4
	Depending on the disease	3

4.3.1. Decision-making on vaccination and hesitancy

Within the first theme, categories related to the vaccine decision-making process emerged. The participants assessed the decision-making process as being hard and time-consuming, which indicates complexity and duration:

> *I was so doubtful, I think every parent goes through such phases (...) it was really a struggle. (p2, 397)*

Emotions and intuition seem to play an important role in this process. Specifically, participants commonly talked about the fear of vaccine side-effects and a strong desire to protect their child from being vaccinated, a feeling they frequently labelled as ‘instinctive’:

You get so frightened, it is fear, when you hear all that and see a child with side-effects, and you just fear it. (p5, 1538)

You have like an instinct in you, which tells you, I don't even know how to explain it. (p13, 5074)

Next, they also talked about how social connections had a significant impact on the decision. This was most commonly related to other people's experience with perceived side-effects, as well as engaging in conversation with people who are opposed to vaccination:

The testimonies of other parents who suffered side-effects (…) I remember crying (…) as a new mother, that was so awful for me (…) I was like – no, I want to protect my child as much as I can. (p9, 3455); I feared polio, but again she convinced me otherwise. (p9, 3739)

When I was pregnant, I was at his place (alternative practitioner), and he just mentioned to me 'if you can, be careful about vaccines'. (p19, 7128)

In some situations, partners held opposing views on their child's vaccination which became a source of conflict. Similarly, some participants also described ways in which they nudged their partner into changing their mind about vaccination, whereas one respondent described avoiding contact with extended family members because they were opposed to the decision:

My husband was for vaccinating (…) but when I showed him pictures of some children, other people's experience, side-effects, he was shocked, so he eventually changed his mind. (p19, 7267)

The respondents most frequently informed themselves on the Internet and vaccine-related groups or forums, and regardless of the source of information, they perceived it as trustworthy:

Hereby the Internet played a big role, but also lectures, different civil engagements… (p7, 2431)

These are not my words, it is what scientists said, I have talked with immunologists, I do not read it on some forum, I talk to doctors (…) not lay people, I have information not from some forum but from professionals. (p8, 2953)

Interestingly, a few of participants stated they engaged in buying and reading scientifically rigorous papers, including systematic reviews on vaccines:

I have just recently read a report, published in Cochrane in 2017, about the flu vaccine, stating it was 'ineffective, with very small effect sizes, with lots of side-effects' and so on. (p23, 8761)

The obtained results further suggest around half of the respondents initially held positive vaccination attitudes and stated the process of their change is complex and due to various reasons. Primarily, it was related to personal experience with child's health issues, particularly those perceived as vaccine adverse events, as well as spouse's nudging, general negative experiences with the healthcare provider or system in general, or during childbirth:

I was the first to be up for vaccinating, always came early not to miss it (…) after three months she had a rash, atopic dermatitis (…). Should I continue or not… that's when I started thinking. (p2, 370)

If I had not experienced this at the hospital after giving birth, I don't know, I would have probably vaccinated. (p9, 3516)

Other reasons also included a reshaping of priorities and embracing a healthier lifestyle, or having suffered from vaccine side-effects:

When you first have a child, you start to think about him (…) your view is widened, as I am mindful about his food (…) the issue of vaccinating just came that way to. (p21, 7857)

After the second polio vaccine, my husband got infected with polio by the vaccine and one of his legs is still disabled. (p22, 8130)

4.3.2. Reflection on the decision

This theme was most frequently identified among others and had the largest number of categories. The respondents commonly justified their decision on not vaccinating by wider personal beliefs, such as their worldview, religious or moral beliefs, as well as specific beliefs about parenthood:

I am not 'a man of the system', I do not follow where others go, and I want to think with my own head and I do not support single-mindedness (…) (p15, 5654)

If one can decide whether or not to abort a child before the 10th week, I do not see why one should not decide on vaccinating too. (p9, 129)

There can be no coercion for it, not from the system, ministry, state, anyone, because it should be a personal decision. (p14, 5280)

First of all, I am religious, I believe in Jesus Christ (…) (p23, 8631)

Parenthood beliefs primarily referred to a great burden of responsibility regarding the child's health which is placed on them as parents and which opposes a general lack of responsibility among institutions and healthcare professionals:

If something happens, no one is responsible but the parent, no one. You can knock on a thousand doors and no one will help you, and you have an ill child at home, which is awful. (p23, 9027)

Next were beliefs related to health, whereby some respondents stated general health in the population was getting better, opposed to some who stated it was getting worse. Interestingly, both argued it to be a reason against vaccinating. The latter group stated that vaccines contributed to the worsening of health, and the former stated that because of improved general health, vaccines were no longer necessary:

Nowadays everyone is sick. Everyone has something. I do not know anyone who is completely healthy anymore. (p13, 4959)

Starting with nutrition, pollution of water, air and soil, and of, course, vaccines… It is all a great burden for a child's body, especially if administered right after birth (…) (p14, 5253)

Next, many participants stated they used alternative and complementary medicine:

This (alternative medicine) has brought me concrete results. I would gladly use it again and again. (p14, 5521)

Moreover, the respondents commonly argued that immunity for diseases can be acquired naturally, opposed to immunization which was perceived as artificial:

It is preferable to get over the so-called children diseases, because then they pass in a few days, mostly without complications and you get lifelong immunity. (p2, 578)

Furthermore, they also perceived infectious diseases as mostly eradicated due to better life conditions and hygiene, therefore as not serious or common:

I honestly do not think vaccines contributed greatly to the elimination of these diseases and its eradication. I think it is due to better hygiene and health and lifestyle. (p13, 5051)

Related to this, a few participants believed vaccines were contributing to maintaining infectious diseases and the reason some have not been fully eradicated by now. As for media reports on infectious outbreaks, such as measles, the respondents commented it as media spins with the purpose of infusing the public with fear:

> *There was a big fuss on measles in the public, it always happens during the summer, always with fear, giving negative information. (p4, 1264)*

The most frequent categories were related to beliefs about vaccines and immunization, tackling all of their different domains. Firstly, some respondents expressed concern about the validity of associated scientific reports, indicating a lack of understanding and mistrust toward it:

> *There is no study regarding vaccine efficacy, which confirms vaccines actually protect us…there is none. (p9, 3676)*

Secondly, they addressed monovalent versus polyvalent vaccines, perceiving the latter as more dangerous:

> *This vaccinating at the age of one, with 5in1 or 6in1…I think it is a shock to the body. If one would vaccinate, then at least have one by one. (p16, 5940)*

Related to this, some also stated too many vaccines are administered too early and that oral vaccines are safer than injected ones:

> *There are more natural ways of vaccinating, which are not injecting some substances in the muscle of a child, which is completely unnatural and crazy. (p9, 3671)*

Next, they commonly perceived immunization as over-generalized, without sensitivity to individual differences, as well as that children are not routinely tested for sensitivity on vaccine components:

> *The approach to treating, prevention and everything else should be individualized. And there is nothing individualized in the vaccination schedule. It is an uncompromising action done by the law and that is it. (p3, 911)*

> *Means of contraindication are not done well, there is nothing to check the sensitivity to components of the vaccine, and every PIL says one must eliminate if a child is sensitive to an ingredient. We don't do that at all. If you are healthy, you get a vaccine. That is not a proper check. A child should get a much more thorough examination. (p4, 1295)*

A few also compared Croatia to other countries and argued that vaccination is not mandatory there, as well as that vaccines administered in Croatia are of lower quality than those in other countries, also when compared to vaccines used in Croatia a few decades ago:

A lot of countries in Europe which are more developed than us have it that way, and they even have a lot of foreigners. (p1, 134)

Merchandise is not the same for Croatia, the western European market, or the American, or South African… so I do not believe we get the best quality vaccines. (p24, 9269)

These vaccines are not the same as those we had when we were young. Definitely not the same ones which were used 33 years ago, and which are being used today. (p10, 4025)

Next, they commonly perceived vaccines components as repulsive or dangerous:

In making them (vaccines), they use cells of aborted fetuses and that is a fact. (p23, 8635)

The risk of vaccines was perceived as greater than the risk of infectious diseases, and some directly exhibited omission bias in their reasoning:

You take a risk both with vaccinating and not vaccinating. I just keep asking myself whether I want to be the one to blame, knowing that I had him vaccinated even though something bad could happen. (p13, 4879)

Moreover, some addressed herd immunity and stated it was a nonsense concept or expressed a lack of understanding of it. Contrary to this, some understood it adequately but stated their child is not obliged to take risk in order to save others:

It is all presented in a biased way… that 95% must be vaccinated to prevent an epidemic… I think that's, to say the least, rubbish. (p9, 3596)

Where does it say that my child must be a scapegoat and sacrifice himself for anyone else? (p4, 1465)

Participants were also worried about the negative impact vaccines might have on the body:

I have a feeling it is too strong for such a small organism, that it weakens them in a way, probably weakens the immune system. (p11, 4293)

Notably, they also commonly referred to specific conspiracy ideation, mostly related to financial profit coming from vaccines, but also malevolent ideas like poisoning:

I think all of it is out of control, that profit is the primary goal. The way we vaccinate today, the pharmaceutical industry has a primary goal, not in keeping children healthy, but in making profit. (p21, 7786)

The more I read about it and the more research I do, I think it is in a way poisoning people. That may sound like a conspiracy theory or something like that but definitely. (p19, 7046)

It is hard for me to believe it, and I don't want to believe it but everything points out to it… That it is in someone's interest… That the benefit of children is not in someone's interest, obviously not. (p9, 3710)

An interesting example is the comparison of immunization to science-fiction literature:

'Brave new world' is a book which, among other things, addresses social engineering, and this (immunization) is certainly related to it (…). The Strugatsky brothers in Russia in the '70s surely were not allowed to write against vaccination. (…) but they wrote about something that is an ethical problem equivalent to today's mandatory immunization, although vaccination as such is not mentioned, they called it 'fulcomization', in an utopian society etc., but when you strip that down and see the archetypes in this story, you see it is the same problem, any mandatory act… (p7, 2406)

The next important category addressed vaccine related side effects. Its implied mistrust toward registration and tracking of side effects, emphasizing how the officially published rates are not representative:

Statistically, it is impossible that in Croatia there are 150-200 reported side effects, and more than 500,000 vaccines are administered. (…) If the manufacturer stated that 1 out of every 10-11,000 will experience a side effects, it is impossible only 150 are reported. (p23, 8780)

Next, they stated the efficacy of vaccines is being experimented on children, since the vaccines are labelled as under additional monitoring:

This sign (black triangle) means the drug is under tracking and those vaccines are being administered, which means we are… our children are like lab rats. (p8, 2372)

It was noted that some participants reported their children had suffered serious conditions, including atopic dermatitis, allergies, as well as weight loss after vaccination:

He (the child) was vomiting after he was vaccinated, he started vomiting that same day, and it continued for a month, every day. (…) It looked terrifying, like a horror movie. I could not believe a child who was healthy one day can have such a reaction. (p5, 1549)

Furthermore, some noted their physicians denied such issues, which included ignoring or concealing parents' testimonies:

They deny it, all of it. And interestingly, these side effects are reported within the vaccine PIL, but when it happens, no one wants to officially state what it is. (p20, 7808)

Some also expressed their dissatisfaction with the communication with healthcare professionals, such as a general communication style which lacked an open approach to the listener and logical argumentation:

Today, if we look at any social discourse (…), it is much harder to fight using arguments in a discussion, it is much easier to say to someone he is a 'partisan', 'fascist', 'communist', or 'pro-vaxer' or 'anti-vaxx'. You just put a label and suddenly it is not important what the person is saying, he just becomes one of 'these'. (p6, 2119)

Next, respondents frequently referred to physicians who publicly opposed vaccines, they endorsed their arguments as well as received medical documentation from them, for example, to enroll a non-vaccinated child into kindergarten. Interestingly, some participants mentioned that healthcare professionals endorse different opinions privately from the ones they express officially, which further supported their mistrust toward vaccines:

They are afraid because they are under such pressure from their profession, they are afraid to lose their medical license. For me as a lay man, who knows nothing about it, when I hear professionals are not unanimous to that degree that some do not vaccine their kids… I have a friend who is a doctor of immunology and his wife is a physician too, they did not want to vaccinate their kid. (p6, 1801)

Moreover, some respondents directly related the patient-physician communication with developing trust and emphasized that good communication might mitigate both developing and addressing vaccine hesitancy:

Well, for the communication to be better, in general, between the doctors and patients because doctors are tremendously important here, and the people do not know and that is exactly why this is happening, that we have all become 'Google doctors and Google scientists' because we need that information to make decisions, and make reasonable decisions about everything.

And it's especially hard for children, a child cannot make a decision for itself, you have to, and it is so hard, and if doctors would have more time… I know how overworked they are and that they can't afford it but if they would give themselves more will and effort to explain to people in a nice way, to somehow dispel those fears which might be fully irrational, to show that they listen to them and that they want to help and they are here for the people, maybe it would be better for all of us and the communication, and there would be fewer of these alternative ways of thinking. (p18, 6930)

Look, there are still are people whom you can return to 'your right path', but make an effort, talk to people, younger and younger generations are coming, and more information is available than ever… You say we look for information in the wrong places, well it's you who brought us to that! (p23, 8672)

A further category included criticizing healthcare professionals, who were perceived as lacking education on vaccines:

I think they (physician) are not educated enough regarding it and one cannot even fully know about all potential side effects. (p13, 5129)

Respondents commonly stated they had different negative experiences in the healthcare system, such as unprofessional and unpleasant communication or bad practice:

I personally as a patient experienced disrespect from the doctors, like making fun of me or in a way that implies the patient is not intelligent enough or educated enough to know something, that the doctor is more important, and also after childbirth I had a negative experience, I got sepsis, and I was in a critical condition and that was in big part a mistake of the doctors, and "thanks" to that we do not vaccinate our son. (p9, 3284)

We tried to talk to the pediatrician, but he wasn't up for it, he just literally made fun of us, insulted us. (p2, 401)

The next category addressed individual characteristics of the child and the perceived child's best interest. For example, a few respondents stated their child was too sensitive to get vaccinated, while one participant stated she would vaccinate some of her children but not all:

For example, I would not vaccinate my first son but the younger twins I would. They are somehow more resistant, and he is like, somehow… (p1, 71)

Most commonly, however, they felt their child's health was at risk and that vaccinating would contribute to further harm:

I told them I was afraid because he was born prematurely, underweight. (p18, 6644)

They (children) are so fragile and tender and kind… (p3, 973)

Only one respondent reported that the child feared vaccinating, which further affirmed the decision to avoid the vaccine:

Well, my child is so afraid of vaccines. (p11, 4585)

Furthermore, some participants also referred to vaccine attitude as a polarizing social issue, dividing people into anti- or pro-vaccine, and what is interesting, they distanced themselves from being a member of either of these groups:

People are always making fun of parents who do not want to vaccinate, how uninformed they are, that they associate vaccines with autism, that they are being dramatic and making a fuss, but the truth is so far from that. They are highly educated and informed parents who simply wish to take the responsibility for their children into their own hands, who read a little what it is really about, while others just vaccinate and do not think anything over. (p4, 1224)

I mean these people who are against vaccination… There are a lot of things there, from conspiracy theorists, some religious ones, there are a lot a freaks there, no doubt about it being an interesting group but I do not think one should go witch-hunting like that. (p6, 1924)

People can be aggressive, both those who want to vaccinate and those who do not want to. I avoid both of them. (p5, 1648)

Having said that, about the half of the respondents addressed the issue of publicly declaring their attitudes. On the one hand, for some, it represented a private or intimate issue, whereby they were cautious in publicly communicating their decision on vaccination. Others were vocal about their decision and engaged in, for example, civil initiatives aimed at informing the public on vaccine harmfulness:

I also do not share this with other people, only if someone asks me directly, but even then, I am careful about what I will say. (…) At the start of this decision, I had the need to kind of yell at people 'do not vaccinate your child, you do not know what you are doing to them', and I admit I was perhaps wrong to do that. I told it to people who were not ready to hear such a thing… I had a tremendous need to do so but then I realized there is no point to it. (p9, 3752)

I do not discuss that, (...), it is my personal decision, I do not talk about it (...), I think it is a very intimate issue, I would not go saying to anyone I vaccinate, or I do not vaccinate, that is absolutely a very personal thing. (p17, 6411)

I can't wait to go to court, when they call me on why I do not vaccinate, they still have not done that, but I can't wait for that to happen, I really can't wait. (p23, 8889)

It was especially noted that some participants did not declare themselves as anti-vaccine, despite being certain of their decision not to vaccinate their children:

I am not (against vaccinating)! I would not declare myself as 'anti-vaccine' oriented. (p9, 3506)

4.3.3. Avoidance behavior

When asked what they did when a mandatory vaccination term for their child came, some respondents stated they were honest in their straightforward refusal when directly communicating to their health professionals:

I did not deceive them. I just said I do not want to vaccinate my second child and I will take responsibility for it. (p6, 1453)

For several of them, avoiding came easily as their physician was cooperative about it and it led to no further consequences:

Well, our pediatrician is great. He won't say he is against vaccinating, but he is a reasonable man and he also does not force it on us. (p10, 4001)

The same thing happened later with the school doctor who said she has complete understanding for me, and she did not report me, so I have no problems with the system. (p4, 1235)

However, some were given an informed consent sheet concerning the refusal and were asked to sign it, or they were referred to an educational talk with an epidemiologist. A handful of participants were prosecuted and fined, or stopped from enrolling their children in kindergarten:

The first report was at the hospital, I had to sign a paper which said I refuse to vaccinate and that I am informed about the benefits of vaccines (...) after a few weeks, I got a call to go to an informative talk with the epidemiologist, so the doctor can talk to me 'about vaccines' and that I get better acquainted. (p3, 759)

She turned us in to the sanitary inspector, who is by duty obligated to file a court lawsuit, by which we get a fine, and you can get a fine for every vaccine you decline. (p3,725)

The first litigation was for not vaccinating, a few months after the child was born… (p7, 2220)

I can't get my child into kindergarten, because she is not fully vaccinated, and I can't go to work if she is not in kindergarten. (p8, 3088)

Interestingly, one participant explained giving instructions to the child on how to avoid an upcoming vaccination at school, while another excused the child from school on the day the vaccination was scheduled:

When the vaccination was planned in school, I just would not send her to school that day. (p25, 9471)

Some stalled on behalf of different child's health issues, such as muscle hypo and hypertonia, premature and underweight birth, developmental difficulties and autism, and that was commonly accepted by appointed physicians:

I wanted to postpone the vaccination because I believe my child has a weaker immune system. She reacts to food quite bad, (...) has rashes, diarrhea, vomits (...). But my doctor doesn't want to hear about it because she doesn't think it is any kind of an acute condition, and there is no reason not to vaccinate. (p3, 732)

A few respondents obtained medical opinions from physicians which stated the child should be exempt from future vaccination:

He was a neuro-atypical child and the pediatric neurologist did not give permission for the vaccination, we had to ask for her medical opinion first, and she said, 'better not', so the vaccine was avoided. (p12, 4720)

No one is forcing us now. They have taken into consideration the finding which we obtained from an psychiatrist about the exemption. So, I do not have a problem with it anymore. (p16, 6148)

Furthermore, one participant mentioned not being truthful and avoiding vaccination by claiming the child suffered from allergies:

Actually, we said that we have allergies in our family and that we wanted to wait and see what happens when he starts eating food and he actually started getting these rashes, so the doctor

said 'ok, let's wait for a year' but he still had those. When he was two years old, we made an allergy test, and nothing was found. The doctor said we can decide if we want to vaccinate. (p1, 284)

Others mentioned knowing other parents who would malinger, offered bribe, and even altered medical records to avoid vaccination:

I have not been most honest with her (doctor) about it, meaning I did not say I do not want to (vaccinate). (p9, 3312)

Most parents actually lie to their pediatrician and try to postpone vaccinating. (...) Some parents are desperate (...), desperate to such a degree they forge their vaccination medical documentation, just so their child could get into kindergarten. (p19, 7240)

You can go to a second pediatrician, pay her something, she gives you the certificate so you can get the children into kindergarten. (p15, 5848)

As a next strategy, some parents stalled, hoping the issue would disappear and avoided contact with their appointed physicians, as in, ignored their calls or transferred to a private clinic or a less strict physician:

When I contacted the pediatrician regarding my first child, they would ask 'what about the other child, when will we vaccinate her, here is your date so come and vaccinate', I said 'fine' but did not show up. (p8, 3200)

I did not go to that doctor anymore and did the check-ups in a private polyclinic. (p14, 5455)

Of course, I asked around, I was told she (the new doctor) would not condition the vaccination and she would understand us. Even if I have to travel further for the check-ups because it is out of the city. It is not a problem; I would do everything for my son's best interest. (p14, 5466)

A few stated their child was not vaccinated due to oversights of the healthcare professionals, for example, their physician retired, or the child was in a generally good health and did not see the physician often, which implies they disappeared in the healthcare system and this enabled them to avoid vaccination without further consequences:

I went to sign the official statement, the first day the doctor wasn't there, the second day again, and so for ten days we couldn't get to the doctor, so the report did not go anywhere further. (p15, 5816)

They are quite healthy, so we do not go to the doctors' often. (p10, 3965)

Well, we were in a kind of a grey area. We changed the doctor, the other one retired, as so on; we kind of did not get into the system. (p20, 7735)

Finally, two respondents said they knew two families who moved out of Croatia because of the mandatory vaccination policy, while one stated she was unwilling to have a second child because avoiding further vaccination would be a great struggle:

A lot of people leave here because of it. That is certainly not the only reason but those who are a bit more open or alternative; they just pack and move to a country where they won't have problems with it. (...). I think it is a torturous issue here in Croatia, and for young people who do not want to vaccinate their children, I think it is hard. (...). I know such people, who moved to Germany. They did not want to be bothered with it the whole time; they just did not want to. I know two families who moved. (p1, 316)

For example, for this reason I do not want to have a second child. The reason is that I do not have the will for the fight. (p19, 7239)

4.3.4. Dealing with the outcome

The next part of the interview focused on the participants' strategies for dealing with the risk of their children being infected with a vaccine-preventable disease. Several respondents stated they had never considered such an option, therefore lacking any related strategies for dealing with the risk:

I honestly do not know, I will think about it when it happens; why would I even imagine that, what for. (p25, 9613)

In this context, some again argued vaccines are responsible for perpetuating infectious diseases, denying any possibility of their children getting infected:

I am quite certain vaccinating is one of the main things contributing to infection. (p7, 2588)

Most commonly, participants stated they would rely on maintaining a strong body and immune system, and moreover believed their child would only get infected with a milder or less serious form of the disease:

Well then, he would probably get a milder type, because my child has recovered from all the usual childhood diseases, which were all in their mildest form (...) because of his good immune system and his health condition. (p12, 4732)

Some compared the health of non-vaccinated and vaccinated children, stating that the former are in much better health, implying that vaccines contribute to weakening of the body or health:

> *There was a German study which showed that non-vaccinated children are 500 times healthier than vaccinated ones. (p15, 5578)*

One strategy for some participants was to rely on modern medicine, believing it would not be troublesome to find a successful medical treatment in case of an infection:

> *Well, I think today's medicine has a solution for that. (p20, 7718)*

Finally, a few of them emphasized they would feel very guilty in such a case, whereas some again showed omission bias in their reasoning, which both indicate emotional coping:

> *If they got infected with, I don't know, polio or something (...) I would like to kill myself, figuratively speaking, it would be awful. But also, it would be awful if I vaccinated them and something happened, I don't know which is worse. (p6, 2030)*

4.3.5. Reconsidering vaccination

Whether or not they would reconsider vaccination, participants differed in their certainty in the decision. For example, some were determined not to vaccinate their children with future vaccinations and did not reconsider it:

> *In nothing in life am I so determined as in the decision not to vaccinate my child… I have no doubts at all. (p9, 3482)*

A couple of participants did not know whether they would continue to vaccinate. This implies they were at the moment of interviewing still in the decision-making process:

> *We actually just wanted to postpone the vaccination (...) I do not know if we will vaccinate in the end or not, it is still 50-50, I would give us more time. (p3, 904)*

Some were willing to reconsider their not-vaccinating decision and mentioned specific conditions under which they might do so, for example, being given complete assurance on vaccine safety, having benefits clearly presented to them, as well as having a choice between alternative vaccines:

> *If someone guaranteed to me 'it is 100% safe', like my mom told me that things were for her generation. She was told by the pediatrician 'it comes in such small doses, it has no side effects, your child will be protected from this and that', and my mom knew that was it, she*

heard about no case reports, anything disputable, then I would accept it too, and I would love it if that were the case today as well. (p18, 6684)

If there was something which would explain it all in a compelling way, like in a book, YouTube video, documentary or whatever, if someone explained why we should vaccinate against this disease, why one should vaccinate, I would do it, I have nothing against rational arguments, although they also do not have to mean anything (…) (p6, 2036)

I am for the option of paying for vaccines, if I could choose which I want, which is of more quality, in that case I might vaccinate. (p24, 9336)

Finally, a couple respondents did not refer to generally reconsidering but stated they might vaccinate for specific diseases, like those present in distant areas where they might travel, as well as in the case of a tetanus infection:

If I were to travel to, let's say India or a distant country, the South African Republic, or somewhere where conditions of life are different then here, I think I would vaccinate my child against some diseases which we do not face here. (p5, 1522)

This tetanus vaccine is ok. (p10, 4135)

5. DISCUSSION

5.1. STUDY 1: Health decision-making and behavior

This study investigated three general domains of health decision-making and behavior important for health outcomes – leading a healthy everyday lifestyle, additional engagement in healthy behaviors and medical adherence, in relation to individuals' ability and motivation to engage in rational thinking, the tendency toward maximizing, as well as optimism and trust in and satisfaction with the health provider. The obtained results showed that all these health behaviors can to some extent be predicted by the above-mentioned traits, demonstrating that individuals' reasoning abilities and cognitive styles, as well as their emotional processing, contribute to health decision-making and behaviors.

5.1.1. Cognitive styles

As expected, the results showed that both leading a healthy everyday lifestyle and engaging in healthy behaviors were predicted by maximizing, a trait that reflects the general tendency to optimize during decision-making (70). Individuals prone to maximizing – maximizers – invest more time and resources in exploring different possible options when faced with a choice and are determined to make the best choice among them. For instance, this trait was shown to be important in seeking job opportunities, as maximizers often obtain higher starting salaries (71), which indicates that maximizing may lead to favorable life outcomes. On the down side, such extensive searching for optimal decisional outcomes heightens expectations, and maximizers also more frequently exhibit decision avoidance, regret, disappointment and dissatisfaction, besides being more affected by social comparison (especially upward) (21). Moreover, it was shown that the impact of maximizing on decision outcomes depends on the nature of the decision. In other words, maximizing may cause suboptimal outcomes in cases where searching for more and more information is not concordant with the optimal strategy needed to make such a decision. In contrast, when maximizing is concordant with the expected value of choice, maximizers are likely to obtain an objectively better outcome. The maximizing strategy is adaptive in contributing to good alternatives, and objectively good choice results (e.g. salary) but not adaptive in reducing negative emotional states (72). Within the context of health, maximizing might manifest itself in different ways as well (21). For instance, maximizers might hold high standards and on an everyday basis choose a healthy lunch over junk food, buy more quality groceries, incorporate exercise, or choose to go to a more equipped gym. It should be kept in mind that the impact of this trait could also be partly mediated by perfectionism, a trait which is rather closely related to maximizing (21). Even though perfectionism seems to have some negative effects on health, both in general and in specific diseases such as the irritable bowel syndrome, erectile dysfunction or ulcerous colitis (73), it has been demonstrated that one specific dimension of

perfectionism, namely self-orientated perfectionism, is related to better physical health and more positive attitudes towards health, as well as maximizing (74). The results obtained in this study support such claims and indicate that maximizing has positive effects on health, suggesting that further studies should be conducted in order to gain more insight into the mechanisms underlying its contribution.

Apart from maximizing, the results indicate that the need for cognition, a cognitive style which reflects individuals' motivation to engage in rational thinking, also contributes to one domain of health behaviors, namely, following medical doctor's advice. Specifically, individuals with this trait were shown to be more prone to medical adherence. In general, following the advice is vital for both reducing healthcare costs and disease management, and some report odds for beneficial health outcomes are three times lower for individuals who do not follow recommended therapies when comparing with those who do (75). Specifically, low adherence is shown to increase frustration in patients as well as health providers, increase costs, contribute to loss of money, avoidable morbidity and mortality, exacerbation of diseases, hospitalization, and decrease of quality of life (75). Despite its importance for patients as well as the healthcare system, some reports document that every second patient does not fully adhere to his/her physician's advice, which points to non-adherence as a wide-spread issue, suggesting that understanding factors that lead to this type of behavior are of great importance (75). Present findings demonstrate that the need for cognition may underlie some aspects of medical adherence. Related to this, a systematic review of longitudinal psychosocial predictors of non-adherence found the quality of patient's beliefs and cognitions about medication and illness to be a major contributor (76). Similarly, a recent qualitative study demonstrated that general practitioners believe their patients' poor knowledge on illness and medication is one of the main barriers to good adherence (77). In the light of these findings, it may be proposed that a higher need for cognition might motivate, and consequently, lead patients to search and obtain better knowledge on diseases and medication or medical treatments, resulting in a higher motivation to follow GP's suggestions and a better understanding of the need for treatment. In general, individuals with a higher need for cognition want to understand the world that surrounds them. They enjoy thinking and generate more relevant thoughts, as well as engage in correcting thinking biases, are more focused on the quality of arguments in persuasive messages than individuals lower in need for cognition (78). Thus, it might be hypothesized that such individuals would be motivated to follow medical advice if this was presented to them in an appropriate manner. Overall, this result contributes to the current knowledge of inter-individual variations in medical adherence, and could help better understand patient-related factors which relate to non-adherence (76).

5.1.2. Rationality

A novel finding of this study indicates that a second domain of health behavior – additional effort directed toward engaging in healthy behaviors – is predicted not only by individuals' cognitive style but also by the ability to correctly reason in different heuristic and biases tasks associated with System 1. These tasks generally measure individuals' ability to engage in rational thinking, an ability different from general cognitive abilities and intelligence, which significantly impact everyday outcomes. For instance, a study by Bruine de Bruin and colleagues (79) demonstrated that the ability to make rational judgements and decisions was more predictive of everyday decision-making outcomes than cognitive ability itself. In line with this, the result of this study further shows that rational thinking abilities, that is, the ability to resists framing, outcome bias, and different probabilistic reasoning biases, might contribute to health behaviors as well. The underlying effect may be as the one exerted by the aforementioned need for cognition, since more rational individuals may better understand information on the benefits of engaging in various health-promoting activities. Another reason is that individuals who are less prone to heuristic and biased thinking can better control automatic inputs related to System 1, which are often in conflict to System 2 in health-related behaviors. For example, such conflicts are common in the case of phobias, gambling, or overeating. These behaviors may be seen as irrational because they include compulsively behaving in a way that is not concordant with the one explicitly desired behavior (80). In other words, individuals behave in ways they know have negative or unwanted consequences, which are particularly shown to be associated with following the emotional states of craving (25). The ability to override System 1 reasoning measured in this study may therefore be associated with the ability to override such cravings or emotional states. For instance, individuals who are more efficient in this may decide to spend their free time working out rather than doing a more pleasurable activity, like watching TV.

5.1.3. Optimism and trust in and satisfaction with the healthcare system

In addition to cognitive styles and rational abilities, the obtained results indicated another individual trait that contributed to health decision-making and behavior, namely, emotional processing and attitudes towards the medical system. In line with expectations, optimism was found to be a significant contributor, predicting both leading a healthy everyday lifestyle, as well as engaging in additional healthy behavior (including massage and exercise). This resonates with previous research, showing that optimism greatly and beneficially contributes to various health outcomes (81). Particularly, optimism might be crucial for forming beliefs related to the relevance of engaging in an activity for producing expected positive results. For instance, an individual would not engage in exercise if he did not expect it to bring desired results. In other words, optimism might

foster positive expectations of any type of an activity, including those related to health (81), therefore having an indirect impact on objective health outcomes.

Apart from optimism, the obtained results confirm and extend previous findings on the importance of trust in and satisfaction with the health provider. As hypothesized, it was found that individuals who place trust in their healthcare system are also more prone to following their doctor's advice. Trust is recognized as a crucial factor in general patient-physician relationships (82), which fosters patient satisfaction and partnership with healthcare professionals (82). A patient who trusts his appointed healthcare professionals believes they will act in his best interest and provide him with adequate support and assistance regarding medical care or treatments (83). Therefore, trust may be a basic factor for developing attitudes and behavior toward physicians and the healthcare system. Besides contributing to medical adherence, trust and satisfaction with the health provider also predicted leading a healthy everyday lifestyle, which resonates with a growing body of evidence demonstrating that patients' trust is associated with beneficial health outcomes (for a review see 53). The present results implicate that maintaining a healthy everyday lifestyle might be one the mechanism underlying such associations and future studies should investigate the exact paths of these relations.

5.1.4. Conclusions and limitations

Taken together, the results of this study extend previous reports and provide novel findings on the importance of different aspects of cognitive and emotional factors for health behaviors, particularly the ability and motivation to engage in rational reasoning. Although all three assessed behaviors – leading a healthy everyday lifestyle (eating healthy), putting in additional effort in engaging in healthy behaviors (exercise or massage) and adhering to medical advice – fall under the broad category of health behavior, the results showed that various factors contribute differently to these behaviors. In other words, the results demonstrate the complexity of various aspects of health behavior and indicate there is a need for investigating moderating and mediating models of cognition and emotions in this context. For instance, one individual might lead an everyday routine which is concordant to general health advice – eating healthy, having enough sleep, not smoking etc. – but never engage in working out or going to a massage. Furthermore, such a person might not adhere to medical advice, perhaps believing his healthy routine will protect him from infectious diseases and might therefore not get vaccinated.

In interpreting the obtained results, several limitations should be considered. First, this study was correlational, based on which it is not possible to make claims regarding the causal relationships among the explored variables. Furthermore, all utilized measures are based on self-reports that may be associated with a number of biases (84, 85). Therefore, future research should try to link individual

characteristics explored in this study to more objective health behaviors and outcomes, such as annual visits to the GP, weekly amount of exercise, as well as control for present or even past health status of the participants (e.g. hospitalization history). Also, the results obtained in this study were based on a sample consisting of mostly female participants of similar age which limits their generalizability. Despite these limitations, the results generally show that health-behavior research could benefit from incorporating concepts which have so far traditionally been investigated in less applied fields of psychology and related disciplines.

5.2. STUDY 2: Vaccine conspiracy beliefs and attitudes

This study first investigated parental conspiracy beliefs toward child vaccination and vaccination uptake in relation to various socio-demographical variables, emotions toward vaccination, optimism, and the analytical-rational and intuitive-experiential cognitive styles. Secondly, it examined the parental ability to engage in rational thinking in relation to vaccine attitudes that were operationalized using three variables reflecting the affective, cognitive, and behavioral attitude components. Two opposite hypotheses regarding the impact of rational thinking, stemming from bounded and expressive rationality, were tested. As measures of rational thinking, cognitive reflection, and the ability to override heuristic thinking were used, together with disillusionment with authorities, a well-established general tendency impacting vaccine attitudes, that was hypothesized to serve as an identity-forming factor by which attitudes could be polarized, according to the expressive rationality hypothesis.

As expected, the obtained results indicated a strong association between vaccine conspiracy beliefs and vaccine uptake. Also, in line with the postulated hypotheses, both vaccine conspiracy beliefs and vaccine uptake were associated with unpleasant emotions toward vaccination and, to a lesser extent, with individuals' intuitive-experiential cognitive style. Contrary to expectations, individuals' propensity toward analytical thinking did not impact the explored criteria. Furthermore, as hypothesized, disillusionment with authorities was strongly associated with all vaccine-attitude components, while the affective and cognitive components were also associated with heuristic thinking. Contrary to expectations, cognitive reflection did not impact vaccine attitudes in any of the components. Finally, an interaction effect of disillusionment with authorities and heuristic thinking emerged for the cognitive and behavioral component but not the affective component.

5.2.1. Optimism and emotions

First, the results showed that vaccine conspiracy beliefs and uptake were associated with specific unpleasant emotions towards vaccination and not the general tendency towards a positive or negative outlook on life, such as optimism. This result partly contradicts the postulated hypothesis,

since optimism is repeatedly shown to have an important role in motivating health behavior and is beneficent for health outcomes (81). In line with this, it was expected that parental optimism and pessimism might reflect the expectation of their children developing or not developing adverse effects, which would impact avoidance and conspiracy beliefs. The reason why the obtained results did not support the hypothesis regarding the role of optimism may be that optimism vs. pessimism was measured at a general trait level and did not regard specific optimistic and pessimistic expectation toward vaccines, which remains to be explored in future research.

Next, the hypothesis on the role of emotions was confirmed by the obtained results, demonstrating that specific emotions towards vaccination impact vaccine conspiracy beliefs and uptake. Furthermore, these emotions were not limited to fear but included anger, anxiety, repulsiveness, worry, as well as lack of relaxation and calmness, which implies that a general or diffused unpleasant affect underlies vaccine-related cognitions and behaviors. Various investigators have so far demonstrated the importance of affect in motivating behavior in different contexts. Slovic and colleagues (28) thereat propose the *affect heuristic* as a mental shortcut which explains that when an emotionally significant event occurs people instantly respond with the intuitive-experiential system, referring to their emotional pool and searching for readily available positive or negative tags associated with a representation of an event (25). Such tags enable people to faster handle the uncertain and complex world. Similarly to the affect heuristic, Loewenstein's *risk-as-feelings hypothesis* suggests that, in cases of conflict between System 1 and 2, individuals' behavior tends to be driven by anticipatory emotions they experience at the moment of making a decision (29). If the activated emotions about an object are positive, they motivate thoughts and actions towards the source of such emotions, whereas in case of negative or unpleasant emotions, the motivation and thoughts shift toward avoiding the source of those emotions. In the context of vaccines, both the affect heuristic and risk as feelings help explain why parents who have correct knowledge on the paramount importance of immunization still avoid vaccinating their children (86). In line with this, the obtained results suggest that parents experience strong unpleasant emotions related to their child's vaccination which directly motivate avoiding vaccination. Furthermore, research has shown that parents who refuse vaccination generally perceive risks of vaccination as higher than those of infectious diseases (8, 87) and it may be argued that unpleasant emotions might be the underlying factor in this relation. Namely, studies have demonstrated that, in general, the perceived benefits of a technology are inversely associated with perceived risk (87). Also, people base their judgements of a technology or activity not only on what they *think* about it, but also on how they *feel* about it. Moreover, the perceived risk and benefit of a technology may be mediated by the strength of negative and positive emotions associated with that technology (87). In other words, people think of things they like as low

in risk and of things they dislike as high in risk. Therefore, parents might perceive vaccines as high in risk because they hold unpleasant emotions toward them or dislike them.

Moreover, the strong contribution of unpleasant emotions to vaccine conspiracy beliefs is in line with various studies that show that unpleasant emotions such as anxiety, as well as uncertainty or feelings of lack of control contribute to general conspiracy beliefs (88). The authors hypothesize that unpleasant emotional experiences activate specific cognitive processes, including pattern perception and agency detection, which then increase the likelihood of conspiracy thinking (88). Emotional processes might therefore impact behavior both directly and indirectly, through associated beliefs (54, 55). The current findings also suggest a strong association between conspiracy beliefs and vaccination uptake, in a way that higher conspiracy beliefs are related to lower uptake. This is not only consistent with previous studies (54, 55) but also extends these findings to real life child vaccination, indicating a need for further research on this subject as part of a public health issue.

5.2.2. Intuitive-experiential cognitive style

As hypothesized, various findings regarding vaccine hesitancy can be interpreted by taking into account the intuitive-experiential cognitive style. It is known that hesitant parents commonly rely on their own and other people's experiences with adverse events (8), which are especially emphasized on anti-vaccine web pages (89). It may be argued that parents generalize side effects experienced by other people, fearing it could happen to their child as well. Another point is that emotions related to the intuitive system can be subtle or unconscious gut feelings, which means some parents might not be aware of their motivation to avoid vaccines or even able to verbalize it. Moreover, this implies that vaccine attitudes might shift toward avoidance after some intense or repetitive experience with perceived side effects, which means that parents who were not initially opposed to vaccines might refuse future vaccinations after such unpleasant experiences.

Even though faith in intuition contributed to vaccine conspiracy beliefs and uptake to a smaller degree than emotions toward vaccination, this relation was expected as emotions represent a substantial part of the intuitive-experiential cognitive style. In thinking intuitively, people are generally seized by their emotions which they perceive as self-evidently valid, that is, experiencing something equals believing it to be true (20). This means that parents might be seized by unpleasant emotions, such as fears of vaccine side-effects, and develop judgements on the perceived risks of vaccines. Furthermore, although emotions are an essential part of the intuitive-experiential cognitive style, an interesting interaction effect was found. Relying on intuition seems not to be directly associated with lower vaccine uptake, since for parents who hold no strong unpleasant emotions toward vaccination, greater relying on intuition contributed to higher vaccine uptake. This effect was not found in parents with moderate or high unpleasant emotions toward vaccination. This might imply

that parents are seized by both unpleasant and pleasant emotions which then motivate their behavior, to a greater extent than faith in intuition, which further corroborates the superior role emotions have over general intuitive thinking in motivating vaccine uptake.

5.2.3. Socio-demographic factors

Furthermore, the obtained results showed that, apart from emotional and cognitive traits, some socio-demographic factors also impact vaccine conspiracy beliefs. These were not predicted by age, gender, marital status, or political ideology, but were related to education. Higher levels of education were associated with lower vaccine conspiracy beliefs, which further points to similarities between vaccine-related and general conspiracy theories, as this effect had been previously demonstrated (90). This is also a confirmation of a report by Shapiro et al. who found vaccine conspiracy beliefs to be associated with lower education (66). It is suggested that the contribution of higher education to lower conspiracy beliefs is a result of a complex interplay of various psychological factors associated with education. Specifically, people with higher levels of education are less likely to believe in simple solutions to complex problems and feel more in control of their social environment (90). Nevertheless, the exact relation of education to vaccine refusal is still not clear. Studies have shown mixed results, associating both lower and higher education to vaccine refusal (51). Similarly, in this study, education was not found to predict actual vaccine uptake. It may be hypothesized that other variables are associated with uptake at a behavioral level, versus cognitive beliefs. One example are financial fines for vaccination refusal which are common in Croatia (91). Namely, parents might opt to vaccinate despite holding strong conspiracy beliefs because it is more important to avoid such fines.

5.2.4. Disillusionment with authorities

The obtained results next indicated disillusionment with or lack of trust in authorities significantly contributes to all components of vaccine attitudes, as well as that it is a stronger predictor of vaccination than rational abilities. This suggests that parents who feel negatively toward vaccination and avoid vaccination hold more disillusionment with authorities. They feel disappointed, tricked, or deceived by institutions involved in vaccination, which is a confirmation of different previous studies (54). This effect may be related to the so-called *vaccine-confidence gap*, *crisis of public trust* or *vaccine backlash* phenomenon (52) that occurs because parents often get exposed to conflicting messages in the media and lack reliable and easily available information on vaccination. This further leads to disillusionment with the government, academia, healthcare professionals or vaccine manufacturers, which is also influenced by a number of different factors, for instance celebrities' endorsement of anti-vaccination attitudes or the existence of various self-organized social

media tools promoting vaccine hesitancy (52). The findings, therefore, suggest that building trust in authorities could be a potentially beneficial strategy for addressing vaccine hesitancy.

5.2.5. Rationality

The obtained results show that vaccine attitudes were predicted by performance on heuristic and biases tasks, but not cognitive reflection. It was found that parents low in disillusionment with authorities maintained less negative vaccine attitudes regardless of their rational abilities, namely ability to override heuristics and biases. In other words, parents who feel trust in authorities involved in vaccination, expressed more positive vaccine-related beliefs and tended to vaccinate their children more regularly regardless of their rational abilities. A novel and interesting finding is that for parents high in disillusionment with authorities, there was a significant positive correlation between rationality and vaccine attitudes. To put it differently, these parents tended to be more accepting of vaccines the greater their ability to override errors and biases in reasoning tasks was, that is, the more rational they were. This implies that greater proneness toward rational thinking can, to some extent, decrease the negative effects of disillusionment with authorities in forming vaccine attitudes. This moderating effect was identified for the behavioral and cognitive but not the affective attitude component. Therefore, more rational parents have fewer negative beliefs about vaccination and more regularly vaccinate their children but do not have weaker negative emotions toward vaccination, that is, they do not feel less worried, anxious, or afraid of their child's vaccination.

Taken together, the results indicate that rationality impacts the directionality of individuals' attitudes, such that more rational parents maintain attitudes closer to the normative, i.e. more positive attitudes toward vaccination, whereas less rational individuals share stronger negative attitudes toward vaccination, which diverge from the normative. This finding is in line with various items of research in bounded rationality theory, which show that rationality is related to many different important real life decisions (60-62). Moreover, the findings suggest that heuristic errors in thinking lead to decisions which are harmful for individuals' and public health. Therefore, the results support the hypothesis stemming from bounded rationality and not from expressive rationality. Specifically, it was hypothesized that a linear relationship between vaccine attitudes and rational skills would speak in favor of the bounded rationality theory, whereas a relationship moderated by disillusionment with authorities would favor the expressive rationality hypothesis. Although these results do not support the expressive rationality hypothesis, they do not exclude the possibility of other identity-forming factors, besides trust in authorities, contributing to the polarization of vaccine attitudes. Some such factors might be parental moral values (92), religious views (93), parenting styles (94), as well as biomedical beliefs (95). These factors might represent cultural values which could potentially

contribute to the polarization of vaccine attitudes and are suggested as important venues for future research.

The supported bounded rationality hypothesis also resonates with a recent systematic review of heuristics in medical decision-making which identified various types of heuristics in this context (10). Specifically, relating to the content of the measured heuristic tasks, the results suggest that parents who showed lower dependence on salient and vivid personal experience that is in conflict with larger anonymous data, as well as those who focus less on the seriousness of outcomes of a medical decision determined by chance, and those who do not judge actions as worse than equally or more harmful inactions, were more accepting of vaccines regardless of their high disillusionment in authorities.

In contrast to the intuitive and emotional System 1 reasoning, the overall obtained results indicate that the rational and analytical System 2 reasoning had no role in vaccine attitudes or conspiracy beliefs. Namely, parents who adopted negative vaccine attitudes did not differ in cognitive reflection, which was the ability to think analytically and deliberatively to correct the intuitively wrong answers, generally associated with cognitive abilities or the *g* factor. The parents who expressed conspiracy beliefs did not differ in the need for cognition, the motivation to engage in analytical and rational thinking. A similar result had been found in a study which investigated psychological and cultural determinants of vaccine attitudes (96). These results imply that parents who refuse to vaccinate are not less skilled to analytically reason about vaccine-related scientific evidence and facts and that they are not less motivated to invest time and effort in investigating vaccination or to employ their analytic reasoning and reflect on it. Vaccine refusal may emerge as a result of domain-specific reasoning errors related to emotions. In other words, vaccine hesitancy in general is a result of strong unpleasant emotions toward vaccination, which suppress the role of rational reasoning. Such results furthermore suggest that vaccine interventions which are based on analytical and logical approaches may have the potential to fail. Namely, persuasion in emotionally significant contexts best works not by giving logical arguments but by triggering new intuitions (97). Attempts of persuading vaccine-hesitants to reconsider and vaccinate their children might not be effective if they are shown numbers or statistical data, for example, risks of infection or vaccine related adverse events. This resonates with different findings which demonstrate how no fully effective strategies of addressing vaccine hesitancy have been developed (98, 99). Namely, the most important issue with vaccine hesitancy being based in the experiential and not rational system is that, in general, experientially based behavior changes mostly through intense or repetitive experience and are therefore much harder to change (20). It might be a particular challenge to design such interventions. Furthermore, some studies have demonstrated that interventions are also dependent on

the strength of vaccine attitudes and some interventions might backfire and contribute to even stronger refusal (100).

These results further relate to findings which show that the parental choice on child vaccination represents a type of a health decision which is highly involving and burdened with different underlying factors (101), especially its emotional relevance which is related to experiential, intuitive, and System 1 processing (11). In fact, studies have demonstrated that some people ignore objective possibilities of events but only in emotionally important decisions (24). This implies that people have the appropriate potential to reason about risk, but this ability is in some way suppressed in emotionally important scenarios. In other words, they seem to be sensitive to the possibility of an event and not its probability. In the context of vaccines, this might mean that parents do not reason about how likely vaccine-related adverse events are, but whether there is any possibility of an adverse event happening, which further leads to the dichotomization of the decision outcome. For these reasons, the parent's choice on child vaccination might be more prone to biased reasoning than other decisions. A reason for this may be that the cognitive mechanisms rooted in System 1 reasoning are evolutionary older and can be opposed to goals of today's industrialized society. Namely, societies based on knowledge and technology often give advantage to de-contextualization and abstraction of problems, which are more associated with System 2 reasoning (11). In line with the evolutionary implications of kinship (102), it can moreover be argued that parents who refuse vaccination for their children are more concerned with the wellbeing of their own offspring and not of others in society. In other words, they might be trying to maintain their own genetic purpose and avoid exposing their children to the perceived risks of vaccines. Moreover, it has been demonstrated that some parents correctly understand the concept of herd immunity but nevertheless avoid vaccination (86). Doing so, they fail to make the normatively rational choice of contributing to herd immunity.

5.2.6. Conclusions and limitations

Overall, the results confirm the primary importance of emotions, along with the propensity toward intuitive thinking, in the context of both vaccine-related conspiracy beliefs and behaviors, supporting the notion that parents' avoidance is guided by their affect. This indicates that differences in vaccine conspiracy beliefs and uptake do not stem from the lack of motivation to engage in rational and analytical thinking but are based on unpleasant emotions and proneness toward experiential and intuitive thinking, as suggested by the affect heuristic or risk-as-feeling hypotheses. In other words, vaccine-hesitant parents do not lack the skills necessary to rationally understand vaccine-related information, but seem to base their decision on faulty criteria primarily related to emotions, which helps explain the impact negative experiences and vividness of other people's experience play in

vaccine hesitancy (8). General optimism and pessimism do not seem to reflect on specific optimistic or pessimistic expectations parents have regarding their children developing side-effect after vaccinating.

The results moreover demonstrate that parents with more negative beliefs and unpleasant emotions toward vaccination are less skilled in overriding heuristic thinking, and therefore more prone to reasoning biases, which is also in line with different previous findings (56). As for the impact of rationality on vaccine attitudes, the results suggest such attitudes are complex, with different attitude components being influenced by different factors. This would explain why interventions aiming at lowering negative vaccine attitudes have so far shown limited effectiveness (98). In fact, hesitant parents might invest a lot of time and effort in their decision but do so based on inadequate and faulty criteria – such as emotional reactions or vividness of anecdotal stories.

In interpreting these results, several limitations should be kept in mind. First, all the data was correlational and based on self-reports and as such is associated with various biases (84, 85). The data can also not be used to interpret causal relations. Next, it was obtained on a non-representative sample of mostly female participants with similar socio-demographic characteristics. Furthermore, the findings are limited due to various threats to validity, common for online questionnaires, such as response and selection bias (103). There was also no possibility of controlling whether the survey was forwarded to other closed Facebook groups, which could have potentially further biased the sample. Also, no information about different vaccines was collected, as one vaccine could be more emotionally evoking than other ones. The Emotions toward vaccination scale is not a standardized instrument and it addressed only limited emotional states, so future research should focus on differentiating between emotional states in a systematic way. Further investigations should focus on potential mediating or moderating effects between all the tested variables in a longitudinal design. Finally, the measure of heuristic reasoning consisted of three tasks, and some authors argue against computing different tasks in a single measure because it is questioned whether they all measure a single underlying construct (104). Nevertheless, the obtained results contribute to the understanding of vaccine refusal as a public health problem and have the potential to be used as a basis for developing strategies aimed at educating individuals to make better health decisions, thus contributing to the rationalization of costs in healthcare and reduction of preventable diseases.

5.3. STUDY 3: Decision-making underlying the avoidance of child vaccination

This study aimed at investigating decision-making processes of parents who refuse to vaccinate their children, with an emphasis on behavioral strategies of avoiding mandatory vaccination and dealing with risk of infection, as well as reconsidering vaccination. The obtained results identified parental decision-making as complex and time-consuming, as well as driven by emotional factors and

highly sensitive to social influences and pressures. Therefore, it may be argued that in this context, rational reasoning has a lesser impact than intuitive and emotional drives, which helps to explain why parents leave little room for persuasion aimed at increasing adherence to vaccines which has further implications for health policies.

5.3.1. Decision-making on vaccination and hesitancy

In regard to entering the decision-making process which precedes hesitant attitudes and behavior, various general trajectories were identified. It was demonstrated that a part of parents who refuse vaccination used to adopt positive vaccine attitudes which were challenged by specific unpleasant events which then raised doubts about vaccine safety. These most commonly included unpleasant experiences with the healthcare system and professionals or the perception that their child was in some way endangered. Alarmingly, parents reported some physicians communicated with them in unprofessional ways, for instance, ridiculed them after asking questions about vaccines. Reports indicate that disruptive behavior in healthcare professionals is a recognized issue linked to a variety of adverse events (105), although present in fewer than 5% of workers (106). Since the obtained results also demonstrated the social component of vaccine attitudes and its polarizing role, it is possible to suggest that some physicians build stereotypes or label parents as 'anti-vaxx' and are not motivated to invest effort in helping them resolve their doubts. Furthermore, this notion also relates to the well-recognized issue of parents' significant dissatisfaction with communication on vaccines (8). The obtained results corroborate this notion and indicate parents believe information on side effects is withheld, and that there is a general lack of logical argumentation when it comes to vaccines, which is another reflection of the *vaccine-confidence gap* (52). Apart from the negative experiences with healthcare professionals, experiences with adverse events contingent to time after vaccinating strongly contributed to hesitancy in some parents. Such experiences commonly evoked concern and fear, disrupting the trust in healthcare professionals. For instance, they reported physicians denied, did not recognize or did not acknowledge the possibility that the child suffered side effects which led parents to feel like they had no one to rely on and thus had to 'take matters into own hands'. They perceived avoiding vaccination as beneficial in a way that it protected their children from further similar events. In other words, they believed that in this way they put the child's best interest in focus. This may be a reflection of intensive parenting, which is reported as a dominant parenting style nowadays (94). Particularly, parents who endorse this style emphasize their active role in children's healthcare (107) which may be why parents feel burdened with personal responsibility, which is opposed to the lack of responsibility they that perceive healthcare professionals have.

The obtained results also indicated that, when deciding on vaccination, parents are highly sensitive to social influences and such importance of social relationships is well recognized in general health behavior (108). The obtained results further corroborate these notions, demonstrating that parents are primarily sensitive to complex dyadic spouse's relations, for example a pro-vaccine parent being nudged by their anti-vaccine spouse. Apart from this, the parents sought support from others, commonly referring to other people's anecdotal examples or adverse events related to vaccines, which was also identified in previous studies (8). Such susceptibility toward anecdotal stories is connected to orientation to *health* versus orientation to *risk*, where health-oriented parents prefer anecdotal arguments, and risk-oriented ones prefer statistical arguments (109). One of the reasons why anecdotal examples have such a strong impact on increasing vaccine hesitancy is their emotional vividness (110), which is in line with another present finding which states that emotional and intuitive factors play an important role in the decision on vaccination. Hereby, the fear of side effects and intuitive feelings of 'wrongness' of vaccines were identified as major motivators of avoidance, to such a degree that some parents were even motivated to move from Croatia, or not have any more children. Although the role of emotions in vaccine uptake has been tackled before (8, 58), the results obtained in this study expand these findings and suggest the role of emotions in vaccine avoidant behavior is even more significant. This may be interpreted within an evolutionary framework, which suggests that the emotional system is evolutionary older and has primacy in different ways (29). It can further be argued that parents are evolutionarily particularly sensitized to perceived threats to offspring, which are emotionally more evoking than other types of situations. In line with this, it has been demonstrated that people are generally more prone to deviations from rational thinking in emotionally burdened decisions (24, 111). In the current study, more than half of the respondents held on to some form of conspiracy beliefs also generally found to be associated with feelings of anxiety (88). The presence of emotional, intuitive and conspiracy factors may further be associated with the functioning of the intuitive-experiential cognitive style within dual-processing theories (20). Namely, some studies have shown that relying on the experiential, as opposed to the analytical-rational style, makes individuals generally more susceptible to endorsing statements which are not well thought through (59). Particularly, it is hypothesized that the careful and deliberate information processing related to the analytical-rational style, which increases attention to logical flaws and inaccuracies, is overridden by the experiential style (59). Another line of studies has further shown that attitudes toward vaccination are based in intuition. For instance, a study by Amin and colleagues (92) linked vaccine hesitancy to several moral domains proposed by the Moral Foundations Theory (MFT) within the social intuitionist model, which claims that intuitions form the base for moral judgements, whereas reasoning generally may be viewed as an ex post facto process used to justify those judgements (112). In that context, it was demonstrated that overt parental concerns about vaccines,

both their justification and reflections, may be linked to moral domains as described by the MFT. Particularly, it was shown that a sense of violation within domains of purity and liberty mediates the relationship between those moral foundation and vaccine attitudes (92). The authors argue that these moral foundations promote overt vaccines beliefs which are seemingly unrelated to moral domains. One example is the belief that vaccines contain artificial toxins, whereas infectious diseases represent a natural phenomenon (purity), as well as the belief that mandatory vaccination violates civil liberties under excessive institutional control (liberty). The obtained results support this line of thinking as the participants' referred to their identity relevant values, including worldview, moral, and religious beliefs as a significant trajectory of entering the decision of avoiding vaccination.

5.3.2. Reflection on the decision not to vaccinate

Justifications of beliefs were identified as the most frequent reflection on the decision not to vaccinate. From the framework of social intuitionist model, it may be postulated that parents' intuitions moved them in direction of opposing vaccines, which then motivated justifications of why vaccines are bad for various reasons (8, 58). These justifications confirmed various previous findings regarding the beliefs vaccine-hesitant parents have (109, 113, 114). Furthermore, these beliefs extend to some themes specifically related to Croatia. For instance, comparing Croatia to other countries which do not have mandatory vaccination policies (115, 116) may again be related to the moral domain of liberty, as parents perceived mandatory vaccination as a sign of backwardness. Another example is comparing the vaccine quality in Croatia to those available in other countries. Participants commonly expressed their concerns that lower-quality vaccines are imported to Croatia. They related this argument to why they do not want to vaccinate their children even though they had been vaccinated themselves, implying they had been vaccinated with safer, better quality vaccines that had been domestically manufactured and which are no longer available today. This argument may be linked to various publicly exposed affairs which point to lower quality of some products, such as food and detergents in Croatia (117). In comparison to others, only a few justifications were directly related to the child personally. When these were mentioned, they reflected complex reasoning, such as varying intentions to vaccinate different children depending on their perceived general health status or 'toughness'. This is another example of the common finding that vaccine-hesitant parents perceive child vaccination as overly generalized or not sensitive to individual difference between children (109, 113, 114), which was also found in the current study. Next, it was found that child's health seems to be especially important in the formation of vaccine avoidance. In this context, parents frequently perceived vaccines as a threat to child's compromised health and avoiding vaccination was perceived as a beneficial strategy by which they actively protected their children's health. Many of the participants were also aware of the public image vaccine hesitant parents have and that this is an

issue which polarizes opposing groups, although, interestingly, the participants did not typically identify themselves as members of either group. Parents differed in the extent to which they publicly expressed their attitudes and decisions. On the one hand, some parents were mindful about disclosing these to outsiders, risking raising condemnation or conflicts, and on the other, some were active in trying to inform other parents on the perceived dangers of vaccines, which may both serve as an identity protective strategy (118). Even though vaccine hesitancy emerges from various backgrounds, a commonality for the majority of parents appears to be primarily an interest for information found on various anti-vaccine media, which is a confirmation of previous findings (89). Similar websites have been shown to significantly impact parents' cognitions and behaviors. For example, a recent study demonstrated that viewing an anti-vaccine-oriented web page for 10 minutes dramatically decreases the intention to vaccinate (110). Internet search engines have been shown to be biased in showing hits related to previously searched content in the sense that browsing one anti-vaccine page leads to other similar pages (110). This may contribute to a biased perception of social support by other vaccine hesitant parents. In other words, an understanding of an exaggerated number of like-minded parents may lead to confirmation bias (56). Contrary to this, some parents inform themselves via scientifically valid sources such as Cochrane systematic reviews. This may help explain why some hesitant parents refuse to vaccinate their children despite having objectively valid knowledge on vaccines (86), as well as the finding that knowledge-gap based interventions are not particularly effective in reducing hesitancy (98). In this context, Law (119) explains various ways that lead educated and intelligent people to develop beliefs which are opposed to rationality or science, and his examples resonate with research repeatedly showing reasoning in vaccine hesitancy to be burdened with various reasoning flaws (56).

5.3.3. Vaccination-avoidance behavior

As one of the aims of the study was to characterize strategies that parents use to avoid mandatory vaccination, it is important to give a general framework on vaccination procedures in Croatia. Croatian health policies state that child vaccination is mandatory, free of charge and provided by GPs, pediatricians, epidemiologists, and other specialist doctors who are all obligated by law to provide this health service. In cases when parents refuse their child's vaccination, the healthcare workers refer them to counselling but may also report them to the Sanitary Inspection Unit of the Ministry of Health, and they may be financially fined (91). The current results point out that vaccine avoidance was primarily associated with features of the parents and their appointed physician, as well as their relationship. These features seem to depend mostly on public disclosure of their decision and fear of further consequences. Regarding features of the physicians, the avoidance seemed to be associated with their degree of tolerance to hesitancy and level of involvement with the patient. In

other words, parents differed in their openness to disclose their decision to physicians. Some did not communicate it openly and avoided contact with physicians, including ignoring their calls, transferring to another less strict physicians, or going for examinations to a private clinic. For those who honestly communicated not wanting to continue vaccination, the consequences depended on their physician's approach. In case the physician accepted the decision, no further consequences arose. However, when the physicians did not accept the decision, this would lead to various further problems, such as lawsuits or the child not being allowed to enroll into kindergarten. Next, the parents who did not openly communicate their decision also differed in the degree of malingering – including staling on behalf of child's health, adulteration of medical records or even bribing the physician. These findings further point to the significant role healthcare professionals play in addressing hesitancy (91, 120, 121). Namely, some healthcare professionals tolerate parents' negative vaccine attitudes or have loose ties to their patients which contribute to easier avoidance. Vaccine hesitancy among healthcare professionals is a recognized phenomenon but still under investigation, as the proportion of hesitant healthcare professionals remains unknown (91). For instance, a qualitative study addressing this issue found that some healthcare professionals are against vaccines in general and have concerns about the risks of vaccines as well as the lack of trust in health authorities (91). Within that study, healthcare professionals interviewed in Croatia particularly reported the need for improving their training about vaccines as well as a better communication with patients. Moreover, in that study a minority of the interviewees reported not feeling comfortable addressing vaccine hesitancy with parents, indicating they shared the same doubts about vaccines as parents did. In line with this, avoidance strategies parents use may be directly related to the communication skills and health professionals' attitudes toward vaccination. Apart from that, parents whose physicians did not support or who ignored their avoidance then used malingering or open conflict with physicians as strategies of avoiding vaccination. All these findings generally point out that healthcare professionals should develop a relationship of trust and stronger bonds with the patients which would provide a safe environment to discuss various issues related to vaccine hesitancy and also to prevent parents from disappearing in the system or malingering.

5.3.4. Dealing with the outcome and reconsidering vaccination

Research has repeatedly shown that vaccine-hesitant parents do not perceive the risk of infection with vaccine-preventable diseases as high or serious (8, 122), which was supported by findings in this study as well. The present findings further demonstrated that this also reflects on dealing with the risk of infections. Namely, the parents adopt only vague strategies related to risk of their children being infected with diseases. These included relying on the strength of the child's immune system and believing the child would be infected with a milder form of the diseases, as well

as believing that modern medicine would successfully treat the infection without serious consequences. Alarmingly, some of the respondents had never considered such a risk or insisted that vaccines are the source of diseases, thereby fully denying the possibility of infection. As for reconsidering vaccination, most of the participants appeared determined in their decision not to vaccinate. Those who would reconsider stated several scenarios in which they might do so, which may also serve as suggestions beneficial in tailoring interventions aimed at promoting vaccination rates. These included stronger assurance on vaccine safety, clear communication of the benefits of vaccinating, and the availability of alternative vaccines. A few participants who were otherwise determined not to vaccinate said they would vaccinate if travelling to distant areas or for some specific diseases. This further supports the notion that hesitant parents do not perceive common infectious diseases, such as measles, as dangerous (8, 122) and that they attribute threat to specific diseases or those uncommon to the area where they live.

5.3.5. Implications for public policies

The obtained results confirmed the crucial role healthcare professionals have in both addressing vaccine hesitancy, but also in (indirectly) aiding parental avoidance of mandatory immunization. Given that the healthcare professionals influence patient vaccination uptake, it is crucial to work on the better communication between patients and healthcare professionals. Openly communicating about potential vaccine side effects and acknowledging adverse events when they happen may enhance a positive and trusting patient-physician relationship in the context of vaccines. It is also suggested that healthcare professionals be more mindful to the parents' period of entering the decision-making process in which the parents are particularly sensitive to other peoples' influences. It may be hypothesized this is a crucial period during which physicians could and should maximize their influence in decreasing hesitancy. Next, building stronger bonds between healthcare professionals and parents might furthermore help to identify parents who malinger and disappear in the system. As the results also point to a polarization of attitudes and that parents do not perceive that the physicians work in their child's best interest, it is advised to incorporate findings from social psychology in developing strategies for increasing vaccination uptake. Specifically, it was previously demonstrated that efficient persuasion should come from individuals which people perceive as in-group and not out-group members (123). Therefore, in designing future strategies, it may be particularly important to emphasize the notion that healthcare professionals work in the child's best interest, as well as to consult literature on moral and emotional persuasion (97). Since emotions play a paramount role in both experiential and moral positions, we advise focusing on finding interventions which take this into account. For example, a research demonstrated that persuasion in emotional scenarios works not by giving logical arguments but by triggering new intuitions in the listener (97).

In addition, schools as institutions where immunization frequently occurs may have an important role in identifying and preventing avoidance. For instance, school staff involved in immunization may keep track of children's exemptions on scheduled vaccination and help inform healthcare professionals on the categories of parents that are at potential risk of hesitancy. Finally, as the results demonstrated that parents adopt vague strategies of dealing with risk of infectious diseases, interventions might also aim to educate parents on the objective principles on infection and methods of treating the infected, as well as raising awareness on the futility of other strategies parents might be using.

5.3.6. Conclusions and limitations

Overall, the results of the present study demonstrate that complex and interrelated factors contribute to vaccine hesitancy as well as various trajectories in which parents from different backgrounds reach the same decision. Moreover, cognitive biases, emotions and intuition, moral reasoning and conspiracy ideas can all be related to the intuitive-experiential cognitive style and intuitionist moral reasoning. It is possible both these systems are important in the context of child vaccination, which has a direct implication for future research and strategies aimed at increasing uptake. Furthermore, the mandatory nature of immunization in Croatia does not seem to be a sole sufficient strategy for addressing increasing hesitancy, since various flaws in the patient-physician relation were identified, especially related to changing of initial vaccine attitudes or triggering hesitancy and behavioral strategies of vaccination avoidance. The demonstrated complexity of the decision-making process and the significance of intuitive-experiential thinking and moral reasoning may help to explain why no fully effective strategies for addressing vaccine have so far been found and point to the futility of knowledge-gap based interventions (98). Namely, it is commonly accepted that behavior based on the experiential style is much harder to change and changes only due to repetitive or intense experiences (20), whereas Baron (124) previously demonstrated that moral intuition often has detrimental effects on public health in general. Also, further explorations of the proposed scenarios are advised in which vaccine-hesitant parents may reconsider vaccinating, focusing in more detail on safety and benefits assurance that might promote vaccination, and investigating what parents would expect of the alternative vaccines. Furthermore, the frequency of non-professional behavior of healthcare professionals toward hesitant parents should be explored in more detail, as should related group processes of stereotyping such parents. It may also be important to keep track of parents' negative experiences with the healthcare system, and to debrief them in a way which enables rebuilding related trust and satisfaction, as the results suggest that this is an important trigger for entering vaccine hesitancy. Finally, the results on avoiding vaccination represent

an overview of strategies parents use and merit more in-depth research on the interaction of the healthcare professionals and parents.

As a conclusion, a graphical representation of the identified themes arranged in a set of tentative relationships is offered (Figure 4).

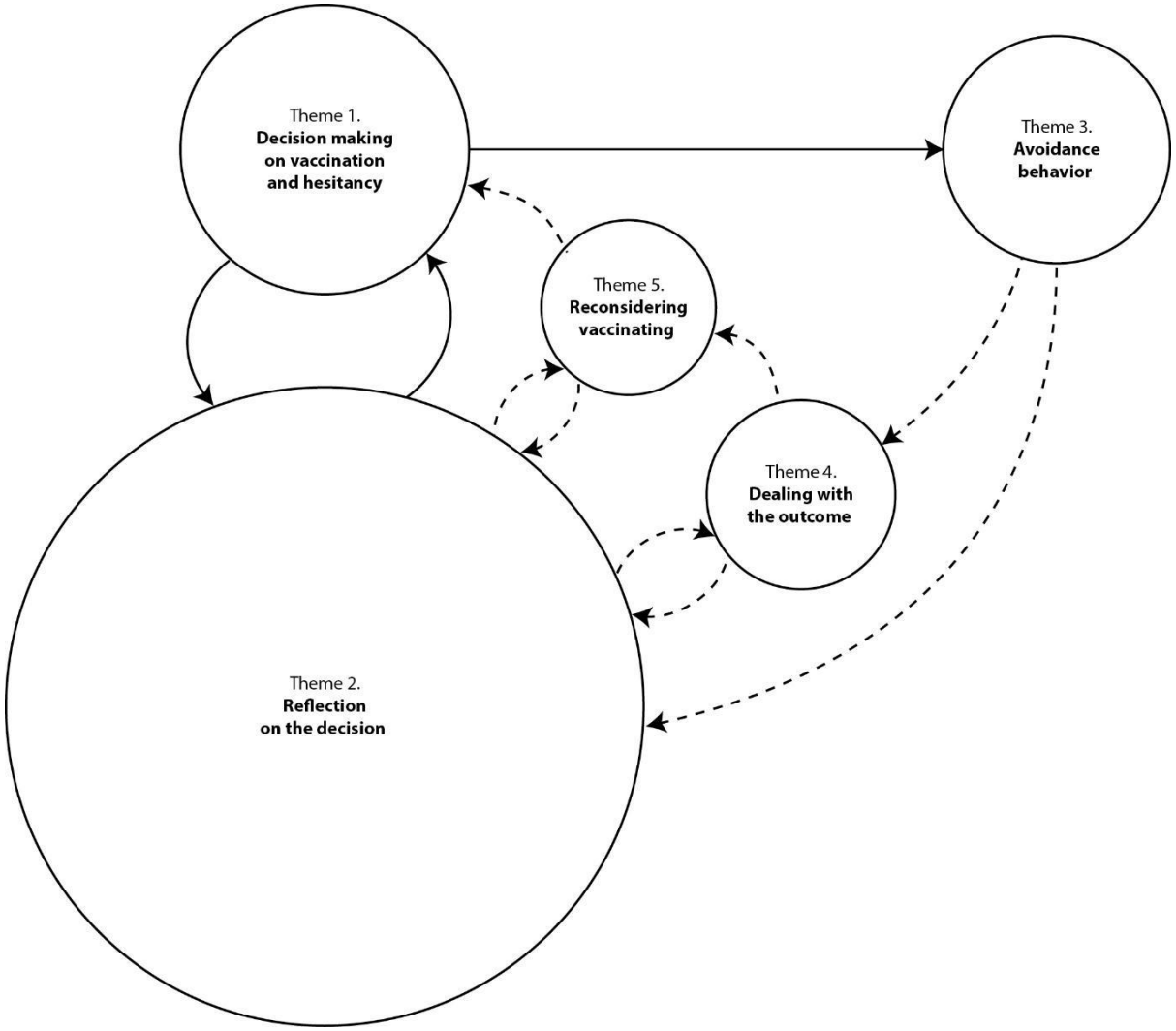


Figure 4. Proposed relations of themes related to parental vaccine decision-making and behavior. Full arrows indicate direct influences and broken arrows indicate potential or probable influences. Sizes of circles represent relative frequencies of identified themes.

Decision-making is directly related to *Reflection on the decision* as a two-way feedback loop where the decision feeds into the reflection, but the reflection also feeds into the decision. The relationship between *Decision-making* and *Avoidance behavior* is an only one-way decision – the behavior follows the decision. This may be partly opposed to the long tradition of research within social psychology which indicates changes in cognition due to behavior. However, in the case of mandatory scheduled vaccination, the decision must come first, even if it is not rational or even

conscious. Once behavior is executed it can lead to further reflection (or rationalization), thus closing the loop. It can also lead to *Dealing with the outcome* (of non-vaccinating), real or imagined, which can, in turn, result in *Reconsidering vaccination* and/or *Reflection on the decision*. All that can subsequently inform *Decision-making* and lead to the new decision-reflection-decision-behavior loop. Furthermore, the results indicate that the frequency in which the specific themes emerged at least in part indicate the relative importance that theme holds for the participants and its' relative contribution to hesitancy. Although it could be argued that the presented themes and their frequencies were evoked by pre-defined questions from the topic guide, it is the interviewer's impression this is true only to a certain, to a rather small degree. Namely, the semi-structured nature of the interviews allowed participants to continue talking on different topics for as long as they wanted and to take the conversation in directions different than pre-defined by the topic guide. In other words, the participants made the final decision which topics to address in detail and which to address more scarcely depending on their own motivation. For instance, even when explicitly asked, respondents gave rather vague and short answers to questions related to dealing with the outcome of the decision and generally did not spontaneously verbalize their positions in that regard. Reversely, their reflections on the decision not to vaccinate seemed to be well-elaborated which indicates that they had considered this issue significantly or argued their positions before. Overall, this indicates that rationalization and related processes may be particularly important in vaccine hesitancy, where parents seek justification of their norm-defying decision. Given that the proposed model is based on a very limited data set and on the authors' interpretation, it is naturally a very tentative model and remains to be tested with more detail and rigor in future studies.

In interpreting the results of this study, some limitations should also be kept in mind. It is worth noting that the interviews were done at one timepoint for each participant, and that some participants reported they still think they are in an ongoing decision-making process, i.e. questioning vaccination and informing themselves. The recruitment strategy was also susceptible to response bias and most of the participants were of high education and socio-economic status. Although the findings lack generalizability, as does other qualitative research, they nevertheless help to explain vaccine hesitant parents' reasoning and related behavior, providing novel insight into the strategies of avoiding mandatory vaccination. Employing this research design enabled gaining an in-depth understanding of the issue and capturing complex data rich in detail (125).

5. CONCLUSIONS

Overall, the results of the conducted studies indicate individuals' health decision-making and the specific decision on child vaccination are associated with some cognitive and emotional traits, and these can beneficially contribute to health supporting behaviors.

1. Leading a healthy everyday lifestyle is associated with higher maximizing as a cognitive style.
2. More frequent engagement in health-promoting activities is associated with higher maximizing as a cognitive style, higher optimism and ability to override heuristic and biased thinking.
3. Higher medical adherence is associated with a greater trust in and satisfaction with the health provider and higher analytical-rational cognitive style.
4. Vaccine conspiracy beliefs, uptake and attitudes are associated with aspects of System 1 reasoning.
5. Greater vaccine conspiracy beliefs are associated with stronger unpleasant emotions toward vaccination and higher intuitive-experiential cognitive style, as well as lower education.
6. Lower child vaccination uptake is associated with parents' greater unpleasant emotions toward vaccination and higher intuitive-experiential cognitive style.
7. All vaccine attitudes components (cognitive, affective and behavioral) are associated with trust toward authorities; individuals with more negative attitudes express greater disillusionment with authorities.
8. The ability to override heuristic and biased thinking is associated with fewer negative vaccine attitudes in the cognitive and affective component.
9. Disillusionment with authorities moderates the association between heuristic and biases tasks, that is rationality, in the cognitive and behavioral attitude components.
10. Parents with low disillusionment adopt more positive vaccine attitudes regardless of their rationality, whereas for parents with high disillusionment higher rationality can decrease the negative effects of disillusionment.
11. Making decisions on child vaccination is complex and associated with different interrelated factors, such as various beliefs, emotions and intuition, social factors, unpleasant experiences within the healthcare system, and communication with healthcare professionals.
12. Making decisions on child vaccination is associated with the intuitive-experiential cognitive style and social intuitionist model of moral reasoning, where the decision not to vaccinate is primarily intuitively motivated and justified by various ex post facto reasons.
13. Parents adopt different strategies by which they avoid mandatory child vaccination, that are related to their own characteristics and characteristics of healthcare professionals.

14. Parents differ in their determination and potential to reconsider their decision on child vaccination, as well as hypothetical situations in which they might do so.

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7. SUMMARY

Introduction: Previous research suggests that decision-making processes related to System 1 and 2 and deviations from rationality can significantly impact individuals' behavior and important life outcomes, including health-related ones. These may be particularly significant in the emotionally burdened context of child vaccination, which may trigger further deviations from rational thinking. Still, it is not fully understood how different cognitive and emotional factors related to these cognitive systems interact, and only a small portion of studies has focused on researching these constructs in the context of health.

Objectives: The aim of this thesis was to address the role of cognitive (cognitive reflection, heuristic thinking, need for cognition, faith in intuition, maximization) and emotional factors (dispositional optimism vs. pessimism, emotions toward vaccination) in the context of other well-known factors (trust in and satisfaction with health provider, trust toward authorities) which contribute to health-decision-making and behavior. The latter included general health decision-making (leading a healthy everyday lifestyle, engagement in healthy behaviors, and medical adherence), as well as the parental decision on child vaccination (vaccine conspiracy beliefs, uptake, and vaccine attitudes in the affective, cognitive and behavioral component). Special focus was also put on vaccine-hesitant parents' reasoning and hypothetical situations in which they would reconsider vaccinating and describing different strategies by which they avoid mandatory vaccination.

Methods: This thesis consisted of three studies. The first was a cross-sectional correlational study with a non-probabilistic sample of 186 volunteer student participants. The second was a cross-sectional correlational study with a non-probabilistic sample of 823 volunteer parents surveyed online. The third, qualitative study included semi-structured interviews conducted with 25 vaccine-hesitant parents recruited through a mixed purposeful sampling strategy.

Results: The results of the first study showed that leading a healthy everyday lifestyle was predicted by maximizing, which also predicted engagement in health-promoting activities. Such engagement was also predicted by optimism and the ability to override heuristic and biased thinking, while a higher need for cognition and trust in healthcare predicted adherence to medical advice. The results of the second study showed vaccine conspiracy beliefs were associated with stronger unpleasant emotions toward vaccination, intuitive-experiential thinking, and lower education, while unpleasant emotions toward vaccination and intuitive thinking were associated with a lesser vaccine uptake. Next, disillusionment with authorities predicted all vaccine attitude components, performance on heuristic and biases tasks predicted the affective and cognitive but not the behavioral component, whereas cognitive reflection had no impact on vaccine attitudes. Finally, a moderation effect of disillusionment on the association between heuristic and biases tasks and the cognitive and behavioral attitude components was identified. Parents with low disillusionment demonstrated positive vaccine

attitudes regardless of their rationality, whereas for parents with high disillusionment a significant positive correlation between performance on heuristics tasks and attitudes was identified, indicating rationality can decrease the negative effects of disillusionment. The results of the third study indicated that decision-making on child vaccination is complex and associated with different interrelated factors, especially the intuitive-experiential cognitive style, as well as supported the social intuitionist model of moral reasoning. Also, it indicated that parents adopt different strategies of avoiding mandatory vaccination and differ in their determination and potential to reconsider their decision, as well as hypothetical situations in which they might do so.

Conclusion: These results provide novel insights on the importance of cognitive and emotional factors in health decision-making. It is demonstrated that vaccine hesitancy is linked to the functioning of the intuitive-experiential cognitive style and that rationality can contribute to health-supporting behaviors in a beneficial manner.

8. SAŽETAK

Doprinos kognitivnih i emocionalnih čimbenika donošenju zdravstvenih odluka

Uvod: Prethodna istraživana pokazuju kako mehanizmi donošenja odluka povezani sa Sustavom 1 i 2 te otkloni od racionalnosti mogu značajno utjecati na ponašanja pojedinaca i različite životne ishode, uključujući zdravstvene ishode. Potonji bi mogli biti od posebne važnosti u kontekstu cijepljenja djece koje predstavlja emocionalno važnu odluku te time može potaknuti dodatne otklone od racionalnog rasuđivanja. Međutim nije u potpunosti jasno u kojem su međuodnosu različiti kognitivni i emocionalni čimbenici povezani s ovim kognitivnom sustavima te se samo manji dio istraživanja bavio ovim konstruktima u kontekstu zdravlja.

Ciljevi: Cilj ove disertacije bio je ispitati uloge kognitivnih (kognitivna refleksivnost, heurističko mišljenje, potreba za spoznajom, povjerenje u intuiciju, maksimiziranje) i emocionalnih čimbenika (optimizam i pesimizam, emocije prema cijepljenju) u kontekstu drugih otprije poznatih čimbenika koji doprinose donošenju zdravstvenih odluka i ponašanju (povjerenje prema i zadovoljstvo sa zdravstvenim sustavom, povjerenje prema autoritetima). Potonji uključuju opće zdravstvene odluke (vođenje svakodnevnog zdravog života, uključivanje u ponašanja koja promiču zdravlje, te slijeđenje liječničkih savjeta), kao i specifičnu roditeljsku odluku o cijepljenju djece (konspirativna vjerovanja o cijepljenju, stavovi prema cijepljenju u afektivnoj, kognitivnoj i bihevioralnoj komponenti). Poseban fokus stavljen je također i na rasuđivanje roditelja koji odbijaju cijepljenje djece i hipotetske situacije u kojima bi cijepili, te opisivanje različitih strategija kojim izbjegavaju obavezno cijepljenje djece.

Metode: Ova se disertacija sastojala od tri istraživanja. Prvo je bilo korelacijsko istraživanje poprečnog presjeka na neprobabilističkom uzorku od 186 dobrovoljnih sudionika studenata. Drugo je bilo korelacijsko istraživanje poprečnog presjeka na neprobabilističkom uzorku od 823 dobrovoljnih sudionika roditelja koji su anketirani putem internetskog upitnika. U trećem kvalitativnom istraživanju putem polu-strukturiranih intervjua ispitano je 25 roditelja koji odbijaju cijepljenje djece, uzorkovanih mješovitom svrhovitom strategijom uzorkovanja.

Rezultati: Rezultati prvog istraživanja pokazali kako je svakodnevno zdravo življenje povezano s maksimiziranjem, koje je također predviđalo i uključivanje u ponašanja koja promiču zdravlje. Takvo uključivanje predviđao je i optimizam te sposobnost prevladavanja heurističkog i pristranog mišljenja, dok su viša potreba za spoznajom te povjerenje prema i zadovoljstvo sa zdravstvenim sustavom predviđali češće slijeđenje liječničkih savjeta. Rezultati drugog istraživanja su pokazali kako su konspirativna vjerovanja o cijepljenju povezana sa snažnijim neugodnim emocijama prema cijepljenju, intuitivno-iskustvenim kognitivnim stilom te nižom razinom obrazovanja, dok su neugodne emocije prema cijepljenju i intuitivno mišljenje bili povezani i s rjeđim cijepljenjem djece. Nadalje, razočarenje u autoritete predviđalo je sve komponente stavova prema cijepljenju, dok je

uspješnost na zadacima heurističkog mišljenja predviđala afektivnu i kognitivnu ali ne i bihevioralnu komponentu. S druge strane, kognitivna refleksivnost nije predviđala ni jedan aspekt stavova o cijepljenju. Konačno, pronađen je i moderacijski učinak razočarenja u autoritete na povezanost između heurističkog mišljenja te kognitivne i bihevioralne komponente stavova o cijepljenju. Pritom su roditelji koji nisu razočarani u autoritete pokazali pozitivne stavove prema cijepljenju, bez obzira na racionalnost, dok je za roditelje koji su vrlo razočarani u autoritete pronađena značajna pozitivna povezanost uspješnost na zadacima heurističkog mišljenja i stavova, što upućuje da racionalnost može umanjiti negativne učinke razočarenja u autoritete. Rezultati trećeg istraživanja pokazala su kako je donošenje odluka o cijepljenju djece složeno i povezano s različitim isprepletenim čimbenicima, naročito intuitivno-iskustvenim kognitivni stilom, te su u skladu s socijalno-intuitivnim modelom moralnog rasuđivanja. Također, pokazano je da roditelji usvajaju različite strategije izbjegavanja obaveznog cijepljenja djece te se razlikuju u odlučnosti i potencijalu za razmatranje svoje odluke, kao i hipotetskim situacijama u kojima bi se predomislili.

Zaključak: Ovi rezultati pružaju nove uvide u važnost kognitivnih i emocionalnih čimbenika u donošenju zdravstvenih odluka. Pokazano je da je oklijevanje oko cijepljenja djece povezano s funkcioniranjem intuitivno-iskustvenog kognitivnog stila te da racionalnost može povoljno doprinijeti ponašanjima koja promiču zdravlje.

9. CURRICULUM VITAE

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Education

- Postgraduate Specialist Study in Clinical Psychology, Faculty of Humanities and Social Sciences, University of Zagreb, 2019-today
- Postgraduate Doctoral Study Translational Research in Biomedicine, School of Medicine, University of Split, 2016-right now
- MA of Psychology, University department of Croatian studies, University of Zagreb, 2012-2014
- Bachelor of Psychology, University department of Croatian studies, University of Zagreb, 2009-2012
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Work experience

- Clinical and Health Psychologist, University Hospital Centre Sestre milosrdnice, Zagreb, February 2020–today
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- School psychologist, Elementary school Kamešnica, March 2019–June 2019
- Research assistant, Department for Psychiatry, University Hospital Split, Split, Croatia, July 2018–April 2019
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- Clinical psychologist, General and Veteran Hospital Knin, April 2017–June 2018

- School psychologist, Elementary school Primorski Dolac, November 2016–December 2016; April 2017–May 2017
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Publications this thesis is based on

Published:

- *It just doesn't feel right - The relevance of emotions and intuition for parental vaccine conspiracy beliefs and vaccination uptake.* **Tomljenović, H.,** Bubić, A. & Erceg, N. Psychology and Health, 2019, Original article, https://doi.org/10.1080/08870446.2019.1673894 IF: 2.401
- *Cognitive and emotional factors in health behavior: Dual-process reasoning, cognitive styles and optimism as predictors of healthy lifestyle, healthy behaviors and medical adherence.* **Tomljenović, H.** & Bubić, A. Current Psychology, 2019, Original article, https://doi.org/10.1007/s12144-019-00268-z IF: 1.468

Under review:

- *Decision making process underlying avoidance of mandatory child vaccination in Croatia – a qualitative study.* **Tomljenović, H.**, Bubić, A. & Hren, D.
- *Contribution of rationality to vaccine attitudes: Testing two hypotheses.* **Tomljenović, H.**, Bubić, A. & Erceg, N.

Other publications

- *Changes in trait brainwave power and coherence, state and trait anxiety after three-month transcendental meditation (TM) practice.* **Tomljenović, H.**, Begić, D. & Maštrović, Z. Psychiatria Danubina, 2016, 28, 15-30. Original article, http://www.ncbi.nlm.nih.gov/pubmed/26938824

Conferences

- *Stress and its management*, *Psychometric testing*, Dynagas Company Conference, 2016, Split

- STAR - Stress and anxiety in a changing society, 2016, Zagreb
- 6th General Assembly Meeting, MILESTONE, 2019, Venice

Conference presentations

- *Contribution of rationality to vaccine attitudes: Testing two hypotheses*. **Tomljenović, H.**, Bubić, A., Erceg, N.
- *Lifelong exposure to stress, inflammatory processes and health outcomes in people with posttraumatic stress disorder*. Britvić, D., Milanović, M., Plejić, N., Kirigin, D., Roca, T., **Tomljenović, H.**, Vučković, M., Đogaš, H., Raos, H., Slavich, G.
- *Comparison of insomnia symptoms in PTSD and complex PTSD*. Milanović, M., Britvić, D., Pleić, N., Kirigin, D., Roca, T., **Tomljenović, H.**, Slavich, G.

Additional career development activities

Advanced education in psychological assessment (MMPI-2, PAI, RCFT, WZT, PTM, BG-2)

Summers schools

- HEIRRI - Higher Education Institutions and Responsible Research and Innovation, 2017
- Summer School of Scientific Communication: Communicating Science to a Broader Audience, 2017
- Croatian Cochrane Symposium, 2018
- Systematic literature review, 2018
- PEERE - New Frontiers of Peer Review, 2018

Peer reviewer

Current Psychology

Journal of Health Psychology

10. APPENDIX 1. STUDY 1. QUESTIONAIRE

Thank you for agreeing to participate in this study, which is a part of Helena Tomljenović's doctoral thesis. The aim is to explore some basic determinants of human reasoning and decision-making. In this study, you will be given several cognitive tasks and questionnaires that you will be asked to complete. Your participation in this study is voluntary and anonymous, and all the collected data will be used for research and scientific proposes only and will not be miss-used in anyway. Therefore, we ask you to give your answers honestly. Before each task, please read the related instructions. Thank you for your effort and cooperation!

Education (If you are a student, please state your current major course and university): _____

Gender: Male Female **Age**: _____

Carefully read the following tasks and answer the questions.

1. A bat and a ball cost $1.10 in total. The bat costs $1.00 more than the ball. How much does the ball cost? _____ cents

2. If it takes 5 machines 5 minutes to make 5 widgets, how long would it take 100 machines to make 100 widgets? _____ minutes

3. In a lake, there is a patch of lily pads. Every day, the patch doubles in size. If it takes 48 days for the patch to cover the entire lake, how long would it take for the patch to cover half of the lake? _____ days

4. When playing slot machines, people win something 1 out of every 10 times. Julie, however, has just won on her first three plays. What are her chances of winning the next time she plays? ____ out of _____

5. A doctor had been working on a cure for a mysterious disease. Finally, he created a drug that he thinks will cure people of the disease. Before he can begin to use it regularly, he has to test the drug. He selected 300 people who had the disease and gave them the drug to see what happened. He selected 100 people who had the disease and did not give them the drug in order to see what happened.

The table below indicates what the outcome of the experiment was:

	Cure	
	Yes	No
Treatment present	200	100
Treatment absent	75	25

Please judge whether this treatment is positively or negatively associated with the cure for this disease.

Circle the number that best reflects your judgement.

-10 -9 -8 -7 -6 -5 -4 -3 -2 -1 0 + 1 +2 +3 +4 +5 +6 +7 +8 +9 +10

strong negative association neutral strong positive association

6. A die with 4 red faces and 2 green faces will be rolled 60 times. Before each roll you will be asked to predict which color (red or green) will show up once the die is rolled. You will be given one dollar for each correct prediction. Assume that you want to make as much money as possible. What strategy would you use in order to make as much money as possible by making the most correct predictions?

Strategy A: Go by intuition, switching when there has been too many of one color or the other.

Strategy B: Predict the more likely color (red) on most of the rolls but occasionally, after a long run of reds, predict a green.

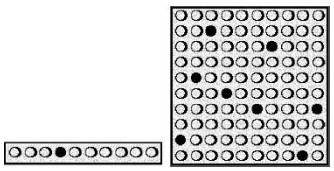
Strategy C: Make predictions according to the frequency of occurrence (4 of 6 for red and 2 of 6 for green). That is, predict twice as many reds as greens.

Strategy D: Predict the more likely color (red) on all of the 60 rolls.

Strategy E: Predict more red than green, but switching back and forth depending upon "runs" of one color or the other.

Which Strategy is best? ___

7. Assume that you are presented with two trays of black and white marbles, a large tray that contains 100 marbles and a small tray that contains 10 marbles. The marbles are spread in a single layer in each tray. You must draw out one marble (without peeking, of course) from either tray. If you draw a black marble you win $2. Consider a condition in which the small tray contains 1 black marble and 9 white marbles, and the large tray contains 8 black marbles and 92 white marbles.



Small Tray Large Tray

From which tray would you prefer to select a marble in a real situation? (check one):

_____ the small tray

_____ the large tray

8. A game of squash can be played either to 11 or to 21 points. Holding all other rules of the game constant, if A is a better player than B, which scoring system will give A a better chance of winning?

____ A will have a greater chance of winning with the 11-point scoring system

____ A will have a greater chance of winning with the 21-point scoring system

____ A's chances of winning are the same under the 11- and 21-point scoring systems

9. Imagine that the United States is preparing for the outbreak of an unusual Alaskan disease expected to kill 600 people. Two alternative programs to combat the disease have been proposed. Assume that the exact scientific estimate of the consequences of the programs are as follows:

a) If Program A is adopted, 200 people will be saved.

b) If Program B is adopted, there is a 1/3 probability that 600 people will be saved, and a 2/3 probability that no people will be saved.

If it was your decision to choose between Program A or Program B, which program would you choose? Circle a) or b).

10. A 55-year-old man had a heart condition. He had to stop working because of chest pain. He enjoyed his work and did not want to stop. His pain also interfered with other things, such as travel and recreation. A successful heart bypass operation would relieve his pain and increase his life expectancy from age 65 to age 70. However, 8% of the people who have this operation die from the operation itself. His physician decided to go ahead with the operation. The operation succeeded. Evaluate the physician's decision to go ahead with the operation.

a) Incorrect, a very bad decision

b) Incorrect, all things considered

c) Incorrect, but not unreasonable

d) The decision and its opposite are equally good

e) Correct, but the opposite would be reasonable too

f) Correct, all things considered

g) Clearly correct, an excellent decision

11. A study tested a new drug for diabetes. The study's aim was to find out whether and to what extent the new drug reduced the risk of heart disease. To evaluate the new drug, 2,000 patients with diabetes were tested. The patients were randomly assigned to two groups: 1,000 patients received the new drug and 1,000 patients received no drug. The patients receiving no drug served as a control group. After five years, the number of patients with heart diseases in each of the two groups was compared. In the control group without the drug 30% of the patients had heart disease. The study showed that the new drug reduced the risk of heart disease by 20%. Please estimate how many patients in the group with the drug suffered from heart disease:

a) 240 out of 1,000 patients who received the drug had heart disease

b) 100 out of 1,000 patients who received the drug had heart disease

c) 200 out of 1,000 patients who received the drug had heart disease

d) 280 out of 1,000 patients who received the drug had heart disease

e) 20 out of 1,000 patients who received the drug had heart disease

Now read the statements below and circle the number on the right side which marks how much you agree with each statement. 1 means you do not agree at all, and 5 means that you agree completely.

I don't like to have to do a lot of thinking.	1 2 3 4 5
I try to avoid situations that require thinking in depth about something.	1 2 3 4 5
I prefer to do something that challenging my thinking abilities rather than something that requires little thought.	1 2 3 4 5
I prefer complex problems to simple problems.	1 2 3 4 5

Thinking hard and for a long time about something gives me little satisfaction.	1 2 3 4 5
I trust my initial feelings about people.	1 2 3 4 5
I believe in trusting my hunches.	1 2 3 4 5
My initial impressions of people are almost always right.	1 2 3 4 5
When it comes to trusting people, I can usually rely on my ‘‘gut feelings’’.	1 2 3 4 5
I can usually feel when a person is right or wrong even if I can’t explain how I know.	1 2 3 4 5
In uncertain times, I usually expect the best.	1 2 3 4 5
It's easy for me to relax.	1 2 3 4 5
If something can go wrong for me, it will.	1 2 3 4 5
I'm always optimistic about my future	1 2 3 4 5
I enjoy my friends a lot.	1 2 3 4 5
It's important for me to keep busy.	1 2 3 4 5
I hardly ever expect things to go my way.	1 2 3 4 5
I don't get upset too easily.	1 2 3 4 5

I rarely count on good things happening to me.	1 2 3 4 5
Overall, I expect more good things to happen to me than bad.	1 2 3 4 5

Now read the statements below and circle the number on the right side which marks how much you agree with each statement. 1 means you do not agree at all, and 7 means that you agree completely.

No matter how satisfied I am with my job, it's only right for me to be on the lookout for better opportunities.	1 2 3 4 5 6 7
When I am in the car listening to the radio, I often check other stations to see if something better is playing, even if I am relatively satisfied with what I'm listening to.	1 2 3 4 5 6 7
I often find it difficult to shop for a gift for a friend.	1 2 3 4 5 6 7
When I watch TV, I channel surf, often scanning through the available options even while attempting to watch one program.	1 2 3 4 5 6 7
I never settle for second best.	1 2 3 4 5 6 7
No matter what I do, I have the highest standards for myself.	1 2 3 4 5 6 7

Please answer the following questions aimed at your health decision-making.

1. Estimate how much you strive toward living healthy in your everyday life (e.g. eating healthy etc.). Circle the number below which marks you answer, 1 means you don't at all, and 5 means that you completely do.

1 2 3 4 5

Not at all Completely

2. Estimate how often you behave in ways that are focused toward promoting health (e.g. going to work out, massage etc).

a) Every day or a few times a week

b) A few times a month

c) A few times a year or less

3. Estimate how much you follow advice and recommendation given to you by physicians:

a) Never

b) Rarely

c) Sometimes

d) Always

3. Estimate how satisfied you are with the healthcare provided to you by your GP. Circle the number below which marks you answer, 1 means you are not satisfied at all, and 5 means that you are completely satisfied.

1 2 3 4 5

Not satisfied at all Completely satisfied

4. Estimate how satisfied you are with the healthcare provided to you by different physicians who treated you so far. Circle the number below which marks you answer, 1 means you are not satisfied at all, and 5 means that you are completely satisfied.

1 2 3 4 5

Not satisfied at all Completely satisfied

5. Estimate how much you trust different physicians and their medical system. Circle the number below which marks you answer, 1 means you don't at all, and 5 means that you completely do.

1 2 3 4 5

Not at all Completely

For the end, carefully read the following tasks and answer the given questions.

1. Imagine that the United States is preparing for the outbreak of an unusual Alaskan disease expected to kill 600 people. Two alternative programs to combat the disease have been proposed. Assume that the exact scientific estimate of the consequences of the programs are as follows:

a) If Program C is adopted, 400 people will die.

b) If Program D is adopted, there is a 1/3 probability that nobody will die, and a 2/3 probability that 600 people will die.

If it was your decision to choose between Program C or Program D, which program would you choose? Circle a) or b).

2. A 58-year-old man had a degenerative hip condition. He was confined to a wheelchair and had been forced to retire early from work the year before. His sedentary state was causing him to gain weight and he was depressed because he could not work or engage in any recreational activities. He enjoyed his work and recreation and did not want to stop. He consulted his physician, who told him that a successful operation on the degenerative hip would relieve his pain and increase his life expectancy by ten years or more because he would be able to exercise. However, because the operation was complicated and because the man had a mild heart condition, there was a 2% chance that he would die from the operation itself. Nevertheless, his physician recommended the operation. Unfortunately, complications arose on the operating table and the man died of heart failure. Evaluate the physician's decision to go ahead with the operation.

a) Incorrect, a very bad decision

b) Incorrect, all things considered

c) Incorrect, but not unreasonable

d) The decision and its opposite are equally good

e) Correct, but the opposite would be reasonable too

f) Correct, all things considered

g) Clearly correct, an excellent decision

3. A study tested a new drug for diabetes. The study's aim was to find out whether and to what extent the new drug reduced the risk of heart disease. To evaluate the new drug, 2,000 patients with diabetes were tested. The patients were randomly assigned to two groups: 1,000 patients received the new drug and 1,000 patients received no drug. The patients receiving no drug served as a control group. After five years, the number of patients with heart diseases in each of the two groups was compared. In the control group without the drug 30% of the patients had heart disease. The study showed that the new drug reduced the risk of heart disease by 20%. Please estimate how many patients in the group with the drug suffered from heart disease:

f) 24% out of 1,000 patients who received the drug had heart disease

g) 10% out of 1,000 patients who received the drug had heart disease

h) 20% out of 1,000 patients who received the drug had heart disease

i) 28% out of 1,000 patients who received the drug had heart disease

j) 2% out of 1,000 patients who received the drug had heart disease

4. The Caldwells had long ago decided that when it was time to replace their car they would get what they called "one of those solid, safety-conscious, built-to-last Swedish" cars -- either a Volvo or a Saab. When the time to buy came, the Caldwells found that both Volvos and Saabs were expensive, but they decided to stick with their decision and to do some research on whether to buy a Volvo or a Saab. They got a copy of Consumer Reports and there they found that the consensus of the experts was that both cars were very sound mechanically, although the Volvo was felt to be slightly superior on some dimensions. They also found that the readers of Consumer Reports who owned a Volvo reported having somewhat fewer mechanical problems than owners of Saabs. They were about to go and strike a bargain with the Volvo dealer when Mr. Caldwell remembered that they had two friends who owned a Saab and one who owned a Volvo. Mr. Caldwell called up the friends. Both Saab owners reported having had a few mechanical problems but nothing major. The Volvo owner exploded when asked how he liked his car. "First that fancy fuel injection computer thing went out: $400 bucks. Next I started having trouble with the rear end. Had to replace it. Then the transmission and the brakes. I finally sold it after 3 years at a big loss." What do you think the Caldwells should do? Circle One:

a) They should definitely buy the Saab.

b) They should probably buy the Saab.

c) They should probably buy the Volvo.

d) They should definitely buy the Volvo.

11. APPENDIX 2. HEURISTICS AND BIASES TASKS

Omission bias. Described by Ash et al. (57) omission bias is defined according to the maximum vaccine risk a respondent would accept and still vaccinate in a hypothetical scenario. The respondents are asked to check 'yes', 'no'' or 'not sure' and asked to follow up one of the two next questions.

Imagine that, in the state you live in, there had been several epidemics of a certain kind of flu, which can be fatal to children under 3. A vaccine for this kind of flu had been developed and tested. The vaccine eliminates the chance of getting the flu. The vaccine, however, might cause temporary side effects that are also sometimes fatal. The children who die from the side effects of the vaccination are not necessarily the same ones who would die from the flu. Except from these effects, neither the vaccine nor the flu has any long-term effects. Out of every 10,000 children under 3 who are not vaccinated, 10 will die from the flu. This rate applies to all groups of children, regardless of their prior health.

Suppose that the overall death rate for vaccinated children were 5 of 10,000. This rate applies equally to all groups of children, regardless of their prior health. Would you vaccinate your child?

If you answered 'yes', how high would the death rate for the vaccinated children have to be in order to change your mind? (This number should be greater than 5 out of 10,000 children. Remember that the death rate for unvaccinated children is 10 out of 10,000). _____ out of 10,000.

If you answered 'no', how high would the death rate for the vaccinated children have to be in order to change your mind? (This number should be greater than 5 out of 10,000 children. If you would not vaccinate under any circumstances, use 0).

_____ out of 10,000.

Causal Baserate. This problem is described by Fong, Krantz, and Nisbett (126). Preference for the Volvo indicates a tendency to rely on the large-sample information in spite of salient personal testimony opposed to that information. A preference for the Saab indicates reliance on the personal testimony over large-sample information and expert opinion. Any degree of preference for the Volvo is scored as 1 and any degree of preference for the Saab is scored as 0.

The Caldwells had long ago decided that when it was time to replace their car they would get what they called "one of those solid, safety-conscious, built-to-last Swedish" cars -- either a Volvo or a Saab. When the time to buy came, the Caldwells found that both Volvos and Saabs were expensive, but they decided to stick with their decision and to do some research on whether to buy a Volvo or a Saab. They got a copy of Consumer Reports and there they found that the consensus of the experts

was that both cars were very sound mechanically, although the Volvo was felt to be slightly superior on some dimensions. They also found that the readers of Consumer Reports who owned a Volvo reported having somewhat fewer mechanical problems than owners of Saabs. They were about to go and strike a bargain with the Volvo dealer when Mr. Caldwell remembered that they had two friends who owned a Saab and one who owned a Volvo. Mr. Caldwell called up the friends. Both Saab owners reported having had a few mechanical problems but nothing major. The Volvo owner exploded when asked how he liked his car. "First that fancy fuel injection computer thing went out: $400 bucks. Next I started having trouble with the rear end. Had to replace it. Then the transmission and the brakes. I finally sold it after 3 years at a big loss." What do you think the Caldwells should do? Circle One:

a) They should definitely buy the Saab

b) They should probably buy the Saab

c) They should probably buy the Volvo

d) They should definitely buy the Volvo

Sample Size: Squash Problem. Described by from Kahneman and Tversky (12). This task is used to explore participants' understanding that a larger sample size is more likely to approximate a population value if other things are equal. The better player's chances of winning would increase when there are more scoring opportunities, and the 15-point scoring system is the correct choice. All other choices are scored as 0.

A game of squash can be played either to 9 or to 15 points. Holding all other rules of the game constant, if A is a better player than B, which scoring system will give A a better chance of winning?

____ A will have a greater chance of winning with the 9-point scoring system

____ A will have a greater chance of winning with the 15-point scoring system

____ A's chances of winning are the same under the 9- and 15-point scoring systems

Gambler's fallacy. The slot machine problem represents the first gambler's fallacy. The correct response, 1 out of 10, was scored as correct, and all other responses were scored as incorrect.

When playing slot machines, people win something 1 out of every 10 times. Julie, however, has just won on her first three plays. What are her chances of winning the next time she plays? ____ out of _____

Covariation Detection. In this task, participants are asked to judge whether a treatment is positively or negatively associated with the cure for this disease by circling a number from a scale ranging from -10 (strong negative association) to +10 (strong positive association). Negative judgments, which indicate the inefficacy of the treatment, are scored as correct.

A doctor had been working on a cure for a mysterious disease. Finally, he created a drug that he thinks will cure people of the disease. Before he can begin to use it regularly, he has to test the drug. He selected 300 people who had the disease and gave them the drug to see what happened. He selected 100 people who had the disease and did not give them the drug in order to see what happened. The table below indicates what the outcome of the experiment was:

	Cure	
	Yes	No
Treatment present	200	100
Treatment absent	75	25

Please judge whether this treatment is positively or negatively associated with the cure for this disease.

Circle the number that best reflects your judgement.

-10 -9 -8 -7 -6 -5 -4 -3 -2 -1 0 + 1 +2 +3 +4 +5 +6 +7 +8 +9 +10

strong negative association neutral strong positive association

Framing Problem. The disease problem of Tversky and Kahneman (12) is a classic problem in which participants sometimes do not display descriptive invariance, a fundamental assumption of decision theory, and instead display a framing effect. This problem is presented in two parts separately. Descriptive invariance is correct and scored as 1. Violation of description invariance is scored as 0.

Part 1

Imagine that the United States is preparing for the outbreak of an unusual Alaskan disease expected to kill 600 people. Two alternative programs to combat the disease have been proposed. Assume that the exact scientific estimate of the consequences of the programs are as follows:

a) If Program A is adopted, 200 people will be saved.

b) If Program B is adopted, there is a 1/3 probability that 600 people will be saved, and a 2/3 probability that no people will be saved.

If it was your decision to choose between Program A or Program B, which program would you choose? Circle a) or b).

Part 2

Imagine that the United States is preparing for the outbreak of an unusual Alaskan disease expected to kill 600 people. Two alternative programs to combat the disease have been proposed. Assume that the exact scientific estimate of the consequences of the programs are as follows:

a) If Program C is adopted, 400 people will die.

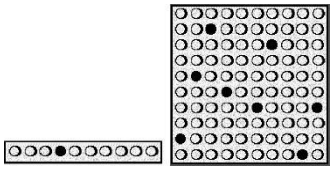
b) If Program D is adopted, there is a 1/3 probability that nobody will die, and a 2/3 probability that 600 people will die.

If it was your decision to choose between Program C or Program D, which program would you choose? Circle a) or b).

Probabilistic Reasoning: Denominator Neglect. This task represents a marble game that was modeled on a task introduced by Kirkpatrick and Epstein (127). The correct response is the small tray, because the chances of pulling a black marble are 10% from the small tray, whereas the chances of pulling a winning marble are 8% from the large tray.

Assume that you are presented with two trays of black and white marbles, a large tray that contains 100 marbles and a small tray that contains 10 marbles. The marbles are spread in a single layer in each tray. You must draw out one marble (without peeking, of course) from either tray. If you draw a black marble you win $2.

Consider a condition in which the small tray contains 1 black marble and 9 white marbles, and the large tray contains 8 black marbles and 92 white marbles.



Small Tray Large Tray

From which tray would you prefer to select a marble in a real situation? (check one):

_____ the small tray

_____ the large tray

Probability Matching. This problem is described by West and Stanovich (128). Participants who prefer Strategy D of predicting "red" for each of the sixty rolls are classified as using the maximizing strategy, which is scored as correct. All other strategies are scored as incorrect.

A die with 4 red faces and 2 green faces will be rolled 60 times. Before each roll you will be asked to predict which color (red or green) will show up once the die is rolled. You will be given one dollar for each correct prediction. Assume that you want to make as much money as possible. What strategy would you use in order to make as much money as possible by making the most correct predictions?

Strategy A: Go by intuition, switching when there has been too many of one color or the other.

Strategy B: Predict the more likely color (red) on most of the rolls but occasionally, after a long run of reds, predict a green.

Strategy C: Make predictions according to the frequency of occurrence (4 of 6 for red and 2 of 6 for green). That is, predict twice as many reds as greens.

Strategy D: Predict the more likely color (red) on all of the 60 rolls.

Strategy E: Predict more red than green, but switching back and forth depending upon "runs" of one color or the other.

Which Strategy is best? ___

Outcome Bias. Investigated by Baron and Hershey (124), this task is composed of two parts presented separately. In part 1, participants are told about a 55-year-old man who had a heart condition and whose operation succeeded. The probability of mortality from surgery was 8%. Participants responded on a 7-point scale ranging from 1 (incorrect, a very bad decision) to 7 (clearly correct, an excellent decision). Later in the battery for part 2 of this problem, participants evaluate a different decision to perform surgery on a patient with a hip condition that was designed to be objectively better than the first (2% chance of death rather than 8%) even though it had an unfortunate negative outcome (death of the patient). If participants rate the decision on the positive outcome case as better than the negative outcome decision, then they have displayed outcome bias. The absence of outcome bias is scored as the correct response for this problem.

Part 1

A 55-year-old man had a heart condition. He had to stop working because of chest pain. He enjoyed his work and did not want to stop. His pain also interfered with other things, such as travel and recreation. A successful heart bypass operation would relieve his pain and increase his life expectancy from age 65 to age 70. However, 8% of the people who have this operation die from the operation itself. His physician decided to go ahead with the operation. The operation succeeded. Evaluate the physician's decision to go ahead with the operation.

a) Incorrect, a very bad decision

b) Incorrect, all things considered

c) Incorrect, but not unreasonable

d) The decision and its opposite are equally good

e) Correct, but the opposite would be reasonable too

f) Correct, all things considered

g) Clearly correct, an excellent decision

Part 2

A 58-year-old man had a degenerative hip condition. He was confined to a wheelchair and had been forced to retire early from work the year before. His sedentary state was causing him to gain weight and he was depressed because he could not work or engage in any recreational activities. He enjoyed his work and recreation and did not want to stop. He consulted his physician, who told him that a successful operation on the degenerative hip would relieve his pain and increase his life expectancy by ten years or more because he would be able to exercise. However, because the operation was complicated and because the man had a mild heart condition, there was a 2% chance that he would die from the operation itself. Nevertheless, his physician recommended the operation. Unfortunately, complications arose on the operating table and the man died of heart failure. Evaluate the physician's decision to go ahead with the operation.

a) Incorrect, a very bad decision

b) Incorrect, all things considered

c) Incorrect, but not unreasonable

d) The decision and its opposite are equally good

e) Correct, but the opposite would be reasonable too

f) Correct, all things considered

g) Clearly correct, an excellent decision

12. APPENDIX 3. STUDY 2. QUESTIONAIRE

Thank you for agreeing to participate in this study, which is a part of Helena Tomljenović's doctoral thesis. The aim is to explore some basic determinants of human reasoning and attitudes toward vaccination. In this study, you will be given several cognitive tasks and questionnaires that you will be asked to complete. Your participation in this study is voluntary and anonymous, and all the collected data will be used for research and scientific proposes only and will not be miss-used in anyway. Therefore, we ask you give your answers honestly. If you have any further questions, feel free to write at helena_tomljenovic@hotmail.com. Before each task, please read the related instructions. Thank you for your effort and cooperation!

Informed consent sheet presented here:

I confirm that I have read the statement above, and that I had a chance to ask questions. I understand my participation is voluntary and that I can withdraw at any moment without giving reasons why and with no legal of health-related consequences. I want to participate in this study.

By marking this button, you agree to participate in the online survey.

Gender: Male Female

What is your education level?

Elementary school

High school

Undergraduate college

Graduate college

What is your profession? _____

How old are you? _____

What is your marital status?

Married

In a relationship

Single

Divorced

Widow

Do you have children? Yes No

If you do, how many: _____

Please estimate your ideological position:

1	2	3	4	5	6
Extremely left/liberal	Moderately left/liberal	Mild left/liberal	Mild right/conservative	Moderately right/conservative	Extremely right/conservative

Carefully read the following questions and answer them:

If you have one or more children, have they received all mandatory vaccination? (If you do not have any children mark „d").

a) My children have received all mandatory vaccinations.

b) My children have received some but not all mandatory vaccinations.

c) My children have not received any mandatory vaccinations.

d) I do not have any children.

Now think about how you feel when you think about vaccinating your child. Read the descriptions below and circle the number on the right side which marks how much you agree with each description. 1 means you do not agree at all, and 5 means that you agree completely.

Anger	1 2 3 4 5
Fear	1 2 3 4 5
Relaxation	1 2 3 4 5
Disgust	1 2 3 4 5
Anxiety	1 2 3 4 5
Repulsiveness	1 2 3 4 5
Worry	1 2 3 4 5
Calmness	1 2 3 4 5

Now read the statements below and circle the number on the right side which marks how much you agree with each statement. 1 means you do not agree with the statement at all, and 5 means that you agree completely.

Childhood vaccines are important for my child's health.	1 2 3 4 5
Getting vaccines is a good way to protect my child/children from disease.	1 2 3 4 5
Childhood vaccines are effective.	1 2 3 4 5
Having my child vaccinated is important for the health of others in my community.	1 2 3 4 5
All childhood vaccines offered by the government program in my community are beneficial.	1 2 3 4 5
The information I receive about vaccines from the vaccine program is reliable and trustworthy.	1 2 3 4 5
Generally, I do what my doctor or health care provider recommends about vaccines for my child/children.	1 2 3 4 5
New vaccines carry more risks than older vaccines.	1 2 3 4 5
I am concerned about serious adverse effects of vaccines.	1 2 3 4 5

As you did before, read the statements below and circle the number on the right side which marks how much you agree with each statement. 1 means you do not agree with the statement at all, and 6 means that you agree completely.

I have given up on those who are involved in immunizations (e.g., the government, pharmaceutical companies, etc.).	1 2 3 4 5 6
Those who are involved in immunizations (e.g., the government, pharmaceutical companies, etc.) are no longer important to me as they used to be.	1 2 3 4 5 6
I feel tricked, cheated or deceived by those who are involved in immunizations (e.g., the government, pharmaceutical companies, etc.)	1 2 3 4 5 6

I am very disappointed with those who are involved in immunizations (e.g., the government, pharmaceutical companies, etc.)	1 2 3 4 5 6
I trust the government to tell the truth about vaccination.	1 2 3 4 5 6
I trust corporations to tell the truth about vaccination.	1 2 3 4 5 6

As you did before, read the statements below and circle the number on the right side which marks how much you agree with each statement. 1 means you do not agree with the statement at all, and 7 means that you agree completely.

Vaccine safety data is often fabricated.	1 2 3 4 5 6 7
Immunizing children is harmful, and this fact is covered up.	1 2 3 4 5 6 7
Pharmaceutical companies cover up the dangers of vaccines.	1 2 3 4 5 6 7
People are deceived about vaccine efficacy.	1 2 3 4 5 6 7
Vaccine efficacy data is often fabricated.	1 2 3 4 5 6 7
People are deceived about vaccine safety.	1 2 3 4 5 6 7
The government is trying to cover up the link between vaccines and autism.	1 2 3 4 5 6 7

In the following questions try to give the correct answer. Carefully read the tasks and write your answer.

A bat and a ball cost $1.10 in total. The bat costs $1.00 more than the ball. How much does the ball cost? _____ cents

If it takes 5 machines 5 minutes to make 5 widgets, how long would it take 100 machines to make 100 widgets? _____ minutes

In a lake, there is a patch of lily pads. Every day, the patch doubles in size. If it takes 48 days for the patch to cover the entire lake, how long would it take for the patch to cover half of the lake? _____ days

Simon decided to invest $8,000 in the stock market one day early in 2008. Six months after he invested, the stocks he had purchased were down 50%. Fortunately for Simon, from July 17 to October 17, the stocks he had purchased went up 75%. At this point, Simon has:

a) Broken even in the stock market

b) Is ahead of where he began

c) Lost his money

If three elves can wrap three toys in an hour, how many elves are needed to wrap six toys in 2 hours? _____ elves

Emily's father has three daughters. The first two are named April and May. What is the thirds daughter's name? _____

Now read the statements below and circle the number on the right side which marks how much you agree with each statement. 1 means you do not agree with the statement at all, and 5 means that you agree completely.

I don't like to have to do a lot of thinking.	1 2 3 4 5
I try to avoid situations that require thinking in depth about something.	1 2 3 4 5
I prefer to do something that challenging my thinking abilities rather than something that requires little thought.	1 2 3 4 5
I prefer complex problems to simple problems.	1 2 3 4 5
Thinking hard and for a long time about something gives me little satisfaction.	1 2 3 4 5
I trust my initial feelings about people.	1 2 3 4 5
I believe in trusting my hunches.	1 2 3 4 5
My initial impressions of people are almost always right.	1 2 3 4 5
When it comes to trusting people, I can usually rely on my ''gut feelings''.	1 2 3 4 5
I can usually feel when a person is right or wrong even if I can't explain how I know.	1 2 3 4 5
In uncertain times, I usually expect the best.	1 2 3 4 5
If something can go wrong for me, it will.	1 2 3 4 5
I'm always optimistic about my future.	1 2 3 4 5

I hardly ever expect things to go my way.	1 2 3 4 5
I rarely count on good things happening to me.	1 2 3 4 5
Overall, I expect more good things to happen to me than bad.	1 2 3 4 5

Carefully read the following tasks and answer the given questions.

1. A 55-year-old man had a heart condition. He had to stop working because of chest pain. He enjoyed his work and did not want to stop. His pain also interfered with other things, such as travel and recreation. A successful heart bypass operation would relieve his pain and increase his life expectancy from age 65 to age 70. However, 8% of the people who have this operation die from the operation itself. His physician decided to go ahead with the operation. The operation succeeded. Evaluate the physician's decision to go ahead with the operation.

a) Incorrect, a very bad decision

b) Incorrect, all things considered

c) Incorrect, but not unreasonable

d) The decision and its opposite are equally good

e) Correct, but the opposite would be reasonable too

f) Correct, all things considered

g) Clearly correct, an excellent decision

2. The Caldwells had long ago decided that when it was time to replace their car they would get what they called "one of those solid, safety-conscious, built-to-last Swedish" cars -- either a Volvo or a Saab. When the time to buy came, the Caldwells found that both Volvos and Saabs were expensive, but they decided to stick with their decision and to do some research on whether to buy a Volvo or a Saab. They got a copy of Consumer Reports and there they found that the consensus of the experts was that both cars were very sound mechanically, although the Volvo was felt to be slightly superior on some dimensions. They also found that the readers of Consumer Reports who owned a Volvo reported having somewhat fewer mechanical problems than owners of Saabs. They were about to go and strike a bargain with the Volvo dealer when Mr. Caldwell remembered that they had two friends

who owned a Saab and one who owned a Volvo. Mr. Caldwell called up the friends. Both Saab owners reported having had a few mechanical problems but nothing major. The Volvo owner exploded when asked how he liked his car. "First that fancy fuel injection computer thing went out: $400 bucks. Next, I started having trouble with the rear end. Had to replace it. Then the transmission and the brakes. I finally sold it after 3 years at a big loss." What do you think the Caldwells should do? Circle One:

a) They should definitely buy the Saabs

b) They should probably buy the Saab

c) They should probably buy the Volvo

d) They should definitely buy the Volvo

3. Imagine that, in the state you live in, there had been several epidemics of a certain kind of flu, which can be fatal to children under 3. A vaccine for this kind of flu had been developed and tested. The vaccine eliminates the chance of getting the flu. The vaccine, however, might cause temporary side effects that are also sometimes fatal. The children who die from the side effects of the vaccination are not necessarily the same ones who would die from the flu. Except from these effects, neither the vaccine nor the flu has any long-term effects. Out of every 10,000 children under 3 who are not vaccinated, 10 will die from the flu. This rate applies to all groups of children, regardless of their prior health.

Suppose that the overall death rate for vaccinated children were 5 of 10,000. This rate applies equally to all groups of children, regardless of their prior health. Would you vaccinate your child?

a) If you answered 'yes', how high would the death rate for the vaccinated children have to be in order to change your mind? (This number should be greater than 5 out of 10,000 children. Remember that the death rate for unvaccinated children is 10 out of 10,000). _____ out of 10,000.

b) If you answered 'no', how high would the death rate for the vaccinated children have to be in order to change your mind? (This number should be greater than 5 out of 10,000 children. If you would not vaccinate under any circumstances, use 0). _____ out of 10,000.

c) I am not sure.

4. A 58-year-old man had a degenerative hip condition. He was confined to a wheelchair and had been forced to retire early from work the year before. His sedentary state was causing him to gain

weight and he was depressed because he could not work or engage in any recreational activities. He enjoyed his work and recreation and did not want to stop. He consulted his physician, who told him that a successful operation on the degenerative hip would relieve his pain and increase his life expectancy by ten years or more because he would be able to exercise. However, because the operation was complicated and because the man had a mild heart condition, there was a 2% chance that he would die from the operation itself. Nevertheless, his physician recommended the operation. Unfortunately, complications arose on the operating table and the man died of heart failure. Evaluate the physician's decision to go ahead with the operation.

a) Incorrect, a very bad decision

b) Incorrect, all things considered

c) Incorrect, but not unreasonable

d) The decision and its opposite are equally good

e) Correct, but the opposite would be reasonable too

f) Correct, all things considered

g) Clearly correct, an excellent decision

13. APPENDIX 4. SOCIODEMOGRAPHIC QUESTIONNAIRE

Gender Female Male

How old are you? _____

Which region do you live in? _____

What is your highest education level?

Elementary school

High school

Undergraduate

Graduate

What is your profession? _____

Please rate your economic status:

Average

Below average

Above average

What is your political orientation?

Extremely left

Left

Center

Right

Extremely right

What is your religious orientation, if any?

Yes, _____

None

What is your marital status?

Married

In a relationship

Single

Divorced

Widow

What is your employment status?

Employed

Unemployed

On leave due to health issues

On parental leave

Retired

Please state how many children do you have, and how old they are:

1.

2.

3.

4.

5.

Please describe your children's vaccination so far, which of the mandatory vaccines they were given and which not:

1.

2.

3.

4.

5.

Was there an epidemic of infectious diseases for which vaccines exist in your living area in the past 5 years?

Yes

No

14. APPENDIX 5. TOPIC GUIDE

You are free to tell us as much about your experience as you want – a lot or a little. We want to understand all that is important to you, we have enough time at our disposal, so you are free to go into details if you want to.

PART ONE (5 min)

Perception of lifestyle, attitudes toward the healthcare system

- Tell me, how do you make sure that you and your family lead a healthy lifestyle?

- What is your experience with physicians and the healthcare system so far?

- Have you used any health services besides those within the classical medicine? E.g. homeopathy…

PART TWO (30 min)

Perception of vaccination and attitudes toward vaccination, formation of attitudes

- Tell me, what do you think of children vaccination?

- How do you perceive the vaccination of your own children?

- How does thinking about vaccinating your child make you feel?

- Which are your views, needs or wishes regarding children vaccination?

- How determined are you in your attitudes?

- What contributed to your realization that you are against mandatory vaccination?

- Did someone or something play a special role thereby?

- Tell me, who or what supports you the most?

- Tell me, where do you find information on vaccination most often?

PART THREE (20 min)

Arguments which support attitudes

- What different reasons do you have against children's vaccination?

- What prevents you from vaccinating your child?

- How efficient do you think vaccines are?

- What do you think of the diseases that the vaccines are for?

- Have you ever heard of a scandal related to vaccines? E.g. a child (you know) who suffered side-effects…

- How was it for you when/if others tried to persuade you to vaccinate your child?

- What would happen if your child would get infected by a disease for which he could have been vaccinated?

- Can you imagine something which might inspire you to reconsider and to vaccinate your child?

PART FOUR (30 min)

Strategies of avoiding mandatory vaccination

- How is children vaccination organized in your place if living?

- What did you do when the time came to vaccinate your child?

- Are there any special ways in which you have so far managed to avoid child vaccination?

- How did you communicate to the superiors that you do not want to vaccinate?

- What made you decide to do that?

- What inspired you to do that?

- How much effort did you have to put into that idea?

- What obstacles did you encounter while avoiding vaccination?

ENDING

Are there any other things that we did not go through and you would like to talk about, or anything to add? Thank you for your time.

Note: while conducting the interviews, the interviewer used several phrases that aided communication, which included:

- Go on… Feel free to say more about that… What happened then, how did that make you feel…
- If I understood you correctly, you said that…
- What is your experience with…?
- How satisfied are you with you doctors so far…?
- How would you rate your knowledge about vaccines in general?
- Do other people share your experience, is it like that for others too…
- How does that make you feel, why do you say that, what, who, how and why…?
- What role did different sources have for you – like medical knowledge, health experts, GP, pediatrician, or others, staff…
- Do you have an example of good or bad practice?
- Which services have you used so far…?
- What are the obstacles to…?
- How would you rate your understanding…?
- What do you think is the best decision…?
- What did you adjust to…?
- What concerns you the most…?
- What was you relation with…
- What about the schedule…

15. APPENDIX 6. CODEBOOK

Field 1. Beliefs				
Category	**Code**	**Codes definition**	**Sub codes**	**Sub code definition**
General	**Worldview**	Statements about a wider way of thinking and living	/	/
	Example: *I am not 'a man of the system', I do not follow where others go, and I want to think with my own head, and I do not support single-mindedness (...) (15-5)*			
	Moral and coercion	Statements about the ethical aspect of free choice	/	/
	Example: *And when you have kids there is a whole thing which starts, you have to do this and that - lithotomy position, what kind of nonsense it that, you have to this, you have to that, you have to go to school, I don't have to do anything! That bothers me, that is my general view of life. (17-10)*			
Social-political	**Responsibility of the state**	Statements about the responsibility of state institutions towards children and parents	/	/
	Example: *If your child gets some side-effects, that everyone has nothing to do with it, there is no one, no doctor, no anyone who will help you. You are on your own, taking care of the child, and nor the doctor who vaccinated nor the doctor who decided on the vaccination aren't there with you. (0_260)*			
	Specific for Croatia	Statements about things specific to Croatia, when compared to other countries	/	/
	Example: *We all know, that the merchandise which comes to Croatia isn't the same as for the western European market, the American, south African, or any. So I do not believe we get the most quality vaccines. (24-5)*			
Health	**Alternative medicine**	Statements about alternative medicine	/	/
	Example: *Yes, yes, yes, I used all kinds of massage, Thailand, shiatsu, acupressure, homeopathy, theta healing…bio resonant therapy, atlas correction, chiropractic, yumeiho... This has brought me concrete results. I would gladly use it again and again. (15-2)*			
	Health nowadays	Statements about general health in todays' society	/	/
	Example: *We don't ask ourselves the question, why a grand dad, the generation born in the '30s, they live for so long, that can't even die, and for us, if you live to be 50 years old - that is good enough, do we ask ourselves why... (8-13)*			

	Immunity	Statements about the immune system	/	/
	Example: *You stay in bed for 2-3 days and do not let the child go outside, he has to keep at rest, it passes and then you get lifelong immunity. While vaccines do not give lifelong immunity. (0-19)*			
	Perception of illness	Statements about illness and diseases	/	/
	Example: *I just know people had gotten over measles before, and there was no drama about it, and today they make drama out of everything. (0-212)*			
	Frequency of illness	Statements about the frequency of infectious diseases	/	/
	Example: *I think some diseases are long eradicated, TBC and so, and I think that if the risk is gone, for the disease to appear, then sure the effectiveness of the vaccines is...surely it only represents a problem to the body. (0-185)*			
Field 2. Vaccination				
Category	**Code**	**Code definition**	**Sub codes**	**Sub code definition**
Vaccination	**Valency**	Statements about vaccinating with multiple vaccines	/	/
	Example: *I am definitely against 6in1 vaccines, that is a very strong vaccine. (0-24)*			
	Taking of vaccines	Statements about ways of taking the vaccine	/	/
	Example: *There are more natural ways of vaccinating, which are not injecting some substances in the muscle of a child, which is completely unnatural and crazy. (0-117)*			
	Other countries	Statements about vaccinating in other countries	/	/
	Example: *I really think there should be a freedom of choice about vaccinating, as thee is in more developed countries, like Germany or so, where there is no big drama about whether you vaccinate your kid or not. (0-22)*			
	Not doing all procedures before vaccination	Statements about doing all necessary procedures before vaccinating	/	/
	Example: *So my pediatrician did not check my kind before the vaccination, let alone anything else, I think often she did not even look at her. (0-281)*			
	Generalization	Statements about over-generalization in immunization, no sensitivity to individual differences	/	/

	Example: *It is all so generalized, and today we are not the same anymore, there is no more plague which infects half of Europe, I don't know, diseases are also quite individualized now, the times have changed, so I think there should be another approach to this. (0-207)*			
	Reporting of side effects	Statements about reporting of vaccine side-effects	1-reporting by doctor	Statements about doctors reporting of vaccine side-effects
			2-reporting by parent	Statements about parents reporting of vaccine side-effects
	Examples: *Even if parents report it, the side-effects exist, the doctors do not report it as they should. (0_264); A big problem is that when you as a parent go to the HALMED web page to fill the report...the problem is that is so lengthy, they ask for such information, it takes you two hours to fill it in, and so it is with the doctors, they have their own way of reporting which is also so.. (0-287)*			
Vaccines	**Ingredients**	Statements about components of vaccines	/	/
	Example: *(...) other substances, like metal, animal DNA, human DNA… (0-121)*			
	Invention	Statements about vaccines as a theoretical invention	/	/
	Example: *I know that generally, as an idea, if it would work 100% and be safe, it would be fantastic (0-219)*			
	Impact on body	Statements about the impact vaccines have on body	/	/
	Example: *It is a fact their little organism (...) By fighting makes anti-bodies against the diseases, while on the other hand you have a child who isn't vaccinated, who came to this world healthy, and not bothered with anything, some substances from the outside, that child has a capacity to fight measles and will survive it. (0-121)*			
	Risk	Statements about perceived risk of vaccinating	/	/
	Example: *Do you believe that for me if is easier to accept this risk that the other one, my son could be like a plant now, immobile. (0-165)*			
	Herd immunity	Statements about herd or collective immunity	/	/
	Example: *No vaccine, not mine or yours, I was born in the '84, it does not protect us anymore, and this is where the herd immunity theory is debunked, it is just so funny. (0-289)*			
	Differences between diseases	Statements about differences between diseases, in seriousness	/	/

	Example: *There are other things bothering us now, god forbid to get polio, it is terrible, when you see a picture of it or read about it, it is horrible, but, the last case was reported so long ago. (0-259)*			
	Quality	Statements about quality of vaccines	/	/
	Example: *The main thing is that vaccines were manufactured in Zagreb then, where they had very strict controls of it, and the vaccines were monovalent not polyvalent. (0-84)*			
Side-effects	**Not reporting or denying**	Statements about not reporting or denying vaccine side-effects	/	/
	Example: *The first thing they will say, the pediatricians, most of them, expect the very ethical and moral ones, is that it is not caused by the vaccine, they will say that. And what is it from? - We don't know, must be something in the air. (0-116)*			
	Reactions	Statements about reactions to side-effects	1-parent	Statements about parental reaction to side-effects
			2-doctor	Statements about doctor's reaction to side-effects
	Examples: *But it is nothing compared to other kind and parents, I see some who do not sleep for days, scratching themselves, having open wounds, I mean, that is so terrible. (0-14); When I saw the doctor's reaction, she gave it no possibility at all, no doubt that is caused by the vaccine. (0-300)*			
	Post-clinical tracking of vaccines	Statements about post-clinical/commercial tracking/monitoring of side-effects	/	/
	Example: *Statistically it is impossible that in Croatia there are 150-200 reported side-effects, and more than 500,000 vaccines are administered. (…) If the manufacturer stated that 1 of every 10-11,000 will suffer a side-effect, it is impossible only 150 are reported. (0-287)*			
	Anecdotal examples	Statements about anecdotal examples of vaccine injured people/children	/	/
	Example: *And she lost her hair, completely, and they tried all sorts of thing, they are wealthy so they could, they tried many things, nothing helped, and it is definitely by the vaccine. (0-209)*			
	(mistrust towards) declared side-effects	Statements about not trusting declared side-effects	/	/

	Example: *We as parents are not educated about it, and when something happens, no one admits it is by the vaccine, and it is stated in the PIL, dermatitis is possible, bronchitis, diabetes, leukemia, multiple sclerosis. When you read the PIL you just freeze of fear. (0-13)*			
Field 3. Child				
Category	**Code**	**Codes definition**	**Sub codes**	**Sub code definition**
Beliefs	**Sensitivity**	Statements about sensitivity to vaccines	/	/
	Example: *I felt so sorry for her, they are so fragile, tender, sweet... (0-30)*			
	Individuality	Statements about individuality of different children	/	/
	Example: *For example, I would not vaccinate my first son, and the younger twins I would. They are somehow more resistant, and he is like, somehow… (0-3)*			
Objective	**Health of child**	Statements about health of child/ren	1-before vaccination	Statements about child's health before vaccination
			2-after vaccination	Statements about child's health after vaccination
			3-general	Statements about general child's health
			4-vaccinated vs non-vaccinated child	Statements about differences in health between children who were and weren't vaccinated

	Examples: *The older kid, after he stopped vaccination, that was when he was 4 years old, and he is 9 now, he did not have one antibiotic, nor was he ill, and before that he was always so...his grandmother sited him, he was not in the collective, he had 4-5 antibiotics, cause his immunity dropped rapidly, just after vaccination, or shortly after. (0-37); He (the child) was vomiting, once he was vaccinated, he started vomiting the same day, and it continued for a month, every day. (…) It looked terrifying, like a horror movie. I could not believe a child who was healthy one day can have such a reaction. (0-48); So he did not take any antibiotics in 10 years, the child is healthy. (0-73); Unbelievable, just unbelievable is the difference, like I said we also have friends who have one vaccinated and one non-vaccinated child, with allergies, and so on... They say it is genetic, well if it is genetic, how come one kid has it and not the other one too? One suffers from all sort of illness, and the other none. The only difference I see is that one was vaccinated and the other was not. (0-285)*			
Field 4. Parents				
Category	**Code**	**Codes definition**	**Sub codes**	**Sub code definition**
Role and style	**Responsibility**	Statements about parental responsibility to child	/	/
	Example: *No one is responsible for our children then us, no one is more responsible than the parents, and the parent is the one who should have the responsibility, a right to vote on all regarding his kid. (9-3)*			
	Autonomy of child	Statements about autonomy of child	/	/
	Example: *I didn't want to vaccinate them when they were 3 months old, or a year, they are 14 now - if they want to get vaccinated, they can do it on their own. (0-57)*			
Health behavior	**Health states and behaviors**	Statements about special health behaviors or states	/	/
	Example: *Of course, I asked around, I was told she (new doctor) would not condition the vaccination and she would be understanding. Even if I have to travel further for the check-ups, because it is out of the city. It is not a problem; I would do everything for my son's best interest. (0-117)*			
Decision-making process	**Initial attitudes**	Statements about initial vaccine attitudes	/	/
	Example: *I was the first to be up for vaccinating, always came early not to miss it. (0_12)*			
	Change of initial attitudes	Statements about changing of initial vaccine attitudes	/	/

	Example: *I found it funny before, when someone said 'mother senses somethings for the child' but I saw for myself, something starts to bother you, you see the child is different in some way, and perhaps someone else would not notice that at all (0-244)*			
	Complexity and length of decision-making	Statements about the complexity of making the vaccine decision	/	/
	Example: *I was so disappointed, on so much torture, doubts, to vaccinate or not to vaccinate, even after I started thinking not to vaccinate...I was actually scared, what if something happens to her... (0-13)*			
	Certainty in decision	Statements about beige certain in the decision of not vaccinating	/	/
	Examples: *Then he realized, he became 100% certain, actually a million percent certain, when our son was born, he is six years old now (0_285); I told her I do not need any tests, I am so certain, so certain... (0-283)*			
	Hypothetical change of decision	Statements about hypothetical factors of changing the decision	/	/
	Example: *If I were to travel to India, let's say, or another distant country, I don't know, South African Republic, or somewhere where there are different life conditions, I think I would vaccinate my child for diseases which exist there, and we don't encounter here. (0-202)*			
Factors in decision-making	**Intuition**	Statements about parental intuition	/	/
	Example: *I started to bother me, something. Really like a mother's instinct. (0-12)*			
	Communication	Statements about communication with doctors	/	/
	Example: *The doctor understood it in a way, he said that we when we were kids, we were vaccinated with 3in1 only. (0-44)*			
	Lack of trust	Statements about lack of trust	1-in doctors	Statements about lack of trust to doctors
			2-in the system	Statements about lack of trust to the system
			3-in science/studies	Statements about lack of in scientific studies regarding vaccines

			4-pharma industry	Statements about hidden motives of pharmaceutical industry in vaccines
	Examples: *I do know that pediatrician do not report the side effects, as our pediatrician did not, and many others. (0-19); Yes, and our political situation, did I say that, I do not trust our politicians and when they impose a law, I do not think it is in the best interest of all of us, I think they do it for their own interest. (24-6); When I see him, he is such a troll, a troll, a mercenary, it is disgraceful who funds his research, how his research is performed, how he designs the research, it is so funny.... (0-284); It is hard for me to believe, I don't want to believe, that someone is systematically trying to poison out children, like make clients for himself, the pharma industry...I don't want to believe in such conspiracy theories, but it makes sense, unfortunately. (9-12)*			
	Emotions	Statements about emotions towards vaccinating	/	/
	Example: *The testimonies of parents whose children suffered side-effects, I remember crying, even now thinking about it, I get tears in my eyes. As a first-time mother, that was so awful for me. (0-111)*			
	Misunderstanding	Statements about subjective misunderstanding of vaccinating	/	/
	Example: *I don't understand somethings, why we get a tetanus vaccine, and if there is an injury, we have to get it again. Why can't I just get the vaccine after an injury occurs, in a few hours or whatever. (0-206)*			
	Experience with health care system	Statements about experiences with health care system	1-positive	Statements about positive experiences with health care system
			2-negative	Statements about negative experiences with health care system
	Examples: *In that moment a very young pediatrician came to me, she was not my appointed doctor, but she was the only one to actually take the effort and explain to me (0-216); That we such a mess, the security had to take me out of the hospital, I had a few of such situations. (0-81)*			
	Religious reasons	Statements about religious motives in making the decision	/	/
	Example: *First of all, the religious reason, I am religious, I declare as such, I believe in Jesus Christ, and I say that to everyone, I don't care at all what someone thinks of that (0-282)*			

	Strategies of dealing with risk	Statements about strategies of dealing with risk of infection when not vaccinating	/	/
	Example: *Honestly, I am not afraid at all, I try to keep the natural immunity, and that is what is most important, the best we can do. (0-239)*			
Reasoning	**Reasoning**	Statements about reasoning about data/risk	/	/
	Example: *And you don't give a single thought about statistics, if your child is one of those, who might get a side-effect. (0-13)*			
	Not having personal expertise	Statements about personal lack of expertise about vaccines	/	/
	Example: *Since I haven't done any research on that, all I can do is trust authorities, one way or the other. (0-54)*			
Field 5. Doctors				
Category	**Code**	**Codes definition**	**Sub codes**	**Sub code definition**
Perception of doctors	**Lack of their expertise**	Statements about lack of expertise doctors have on vaccines	/	/
	Example: *On the other hand, there was questioning about how much do doctors and nurses are educated on vaccination. If what I heard is correct, that's is not so much. (0-231)*			
	Experiences with doctors	Statements about experiences with doctors	/	/
	Example: *And then I had the experience when she enrolled elementary school, the doctor just 'benevolently' said to me that I will have a dead grandchild because I didn't vaccine her for rubella. (0-311)*			
	Doctors against vaccines	Statements about doctors who are against vaccinating	/	/
	Example: *He told us many information, he was the director of the immunology institute, and lost his job because he warned people. Of the non-transparency of the vaccines imported to Croatia, he ended up in jail, the pharma lost his lawsuit later on, so he did go to jail, but bla bla, you get the point. (0-97)*			
Field 6. After the decision				
Category	**Code**	**Codes definition**	**Sub codes**	**Sub code definition**
Avoidance	**Avoidance**	Statements about avoidance of mandatory vaccinating	/	/

	Example: *The pediatrician sent the formal notice, that was in her jurisdiction, she did her job, but we did not formally respond to that, and now we are in a status quo. (0-127)*			
	Consequences	Statements about consequences of avoiding mandatory vaccines	/	/
	Example: *After two or three weeks, after giving birth, I got a call to go to the epidemiological department. Like on an informative talk with an epidemiologist, so the doctor can explain to me 'about vaccines' and educate me (0-24)*			
Field 7. Social aspect				
Category	**Code**	**Codes definition**	**Sub codes**	**Sub code definition**
Relations	**Declared parental attitude**	Statements about publicly declared attitudes of parents	/	/
	Example: *I think it is a very intimate thing, I would never go and say to someone if I did it or did not do it, that is absolutely something very personal. (0-208)*			
	Social media	Statements about social media	/	/
	Example: *I follow these groups on Facebook. (0-110)*			
	Other peoples' role	Statements about role other people had	/	/
	Example: *Actually, he told me when I got pregnant, I was at his place for a treatment and he said to me - if you can, be careful about vaccines, or something like that. (0-232)*			
Communication	**Communication**	Statements about specific features of communication	/	/
	Example: *It is normal that we as parents, who take care of the children, that we get informed, about benefits, side-effects, in an open way. Not to be so secretive... (0-49)*			
	Perception of validity of information sources	Statements about the perception of validity of own information sources	/	/
	Example: *Those are not my words, I spoke to immunologists, I do not read on some forum, I talk to doctors, we have a doctor in our family, do you understand me, I don't talk to lay people, I do not get my information on some forum, I talk to experts. (0-94)*			
	Informing	Statements about informing oneself on vaccines	/	/
	Example: *I could state studies I read, lectures I went to, and books i've read, which are relatively expert, some very are expert. (0-74)*			

	Attitudes in-out group	Statements about attitudes anti and pro vaccine-oriented people have, polarizing attitudes	/	/
	Example: *I am the first not to like anti-vaxx groups, there is always some propaganda spread there, and I don't like any exaggeration in anything. (0-44)*			
	Public image	Statements about public image of anti-vaccine parents	/	/
	Example*: What, are you acting all smart, google parents, google doctors' (0-100)*			
Field 8. Other				
Category	**Code**	**Codes definition**	**Sub codes**	**Sub code definition**
Other	**Extra phenomena**	Statements about some specific phenomena	/	/
	Example: *A lot of people also leave here because of it, it is not the only reason, but it is something that helps people to decide to move, those who are like a bit more open and alternative, just to pack and leave to some country where they won't have any problems with that. I know people who went to Germany. (0-10)*			
	Extreme and wrong beliefs	Statements about extreme and wrong beliefs	/	/
	Example: *I told my husband I would rather give someone to cut off my arm then let him vaccinate my child. (0-108)*			
	Science fiction	Statements about science fiction	/	/
	Example: *'Brave new world' is a book which, among other things, in a part addresses social engineering, and this (immunization) is certainly related to it (...). The Strugatsky brothers in Russia, in the '70s surely were not allowed to write against vaccination. (...), but they wrote about something that is an ethical problem equivalent to today's mandatory immunization, although vaccination as such is not mentioned, they called it 'fulcomization', in an utopian society etc., but when you strip that down and see the archetypes in this story, you see it is the same problem, any mandatory act… (7-9)*			