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Strategic Ignorance of Health Risk—Its Causes and Policy Consequences

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Abstract

We examine the causes and policy consequences of strategic (willful) ignorance of risk as an excuse to overengage in risky health behavior. In an experiment on Copenhagen adults, we allow subjects to choose whether to learn the calorie content of a meal before consuming it, and measure their subsequent calorie intake. We find strong evidence of strategic ignorance: 46% of subjects choose to ignore calorie information, and these subjects subsequently consume more calories on average than they would have had they been informed. We find that strategically ignorant subjects downplay the health risk of their preferred meal being high-calorie, which we formally show is consistent with the theory of optimal expectations about risk. Further, we find that the prevalence of strategic ignorance largely negates the effectiveness of calorie information provision: on average, subjects who have the option to ignore calorie information consume about the same number of calories as subjects who are provided no information.

Keywords: strategic ignorance, willful ignorance, risk perception, optimal expectations, calories, information

JEL codes: D11, D12, D81, D83, D91, I12

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“Sometimes not seeing things can be a blessing.” ~August Strindberg

1. Introduction

Many people are torn between immediate desires (eating chocolate cake, smoking cigarettes, engaging in risky sex, slacking off work) and the desire to sustain longer-term goals (staying slim and healthy, getting a promotion). Due to these conflicting preferences, engaging in risky consumption may cause emotional discomfort, such as anxiety, guilt or shame. However, there may be a (short-run) way of having your cake and eating it too: strategic ignorance of risks. By willfully ignoring risks associated with immediate pleasurable activities, people may allow themselves to overengage in risky consumption.

In this paper, we focus on strategic ignorance of health risks from overconsumption of calories. Our aim is two-fold: to shed light on what mechanism makes ignorance blissful and to examine how strategic ignorance impacts the effectiveness of information policies aimed at steering people away from risky behavior.

We propose that ‘optimal expectations’ play an important role in strategic ignorance. The theory of optimal expectations, developed by Brunnermeier and Parker (2005), suggests that people may ignore risk information to be able to downplay the probability of a bad future state. The resulting benefits in terms of reduced anticipatory anxiety may outweigh the costs in terms of reduced ability to plan for the future.

Oster et al. (2013) find support for this theory in their study of individuals at genetic risk for Huntington disease, an incurable degenerative neurological disorder that typically reduces healthy life expectancy by decades. They find that fewer than 10% of such individuals pursue predictive testing. Moreover, untested individuals perceive their chance of developing the disease to be much lower than the chance determined by investigators based on clinical signs, and make life choices (e.g., childbearing, retirement) that are essentially identical to those of individuals who have tested negative and are therefore certain they will not develop the disease.[1]

Compared to learning whether one has Huntington disease, learning the calorie content of a meal is less consequential. Nevertheless, the same factors are at play: if ignorance of risk enables people to convince themselves that risk is low (the oversized pizza is probably low-calorie), then it also reduces any guilt or anxiety associated with risky behavior (eating the whole thing). People may judge this reduction in negative emotions to be sufficiently desirable in the short term to outweigh any detrimental effect of overconsumption to their long-term health.

Such behavior may, however, undermine the effectiveness of information policies designed to improve public health by curbing risky consumption.[2] A prominent example of such a policy is mandatory calorie labeling in chain restaurants, which is currently scheduled for implementation nationwide in the U.S. to encourage low-calorie meal choices.[3] Menu labeling will be effective only if consumers pay attention to and use the information conveyed. Current evidence on this is not encouraging. Field studies of local menu-labeling mandates that preceded the federal rule (e.g., at the city level in New York, Nashville, and Philadelphia and at the state level in California, Maine, Massachusetts, and Oregon) indicate little or no impact on calorie consumption (Borgmeier and Westenhoefer, 2009; Downs et al., 2009; Elbel et al., 2009, 2011; Bollinger et al., 2011; Vadiveloo et al., 2011).

Our study builds on two prior studies that suggest people might avoid calorie information as an excuse to increase unhealthy food consumption.[4] Thunström et al. (2016) find, in an experiment involving actual consumption of ready meals, that 58% of subjects choose not to

[1] Oster et al. note that a leading alternative model of strategic ignorance, namely Kőszegi's (2003) model (building on Caplin and Leahy, 2001) of information-averse preferences over anticipatory utility, cannot accommodate their finding of biased beliefs.

[2] See Johansson-Stenman (2008) for analysis of such policies when individuals misperceive risks *exogenously*, so strategic ignorance is not an issue.

[3] See https://www.fda.gov/food/labelingnutrition/ucm436722.htm for details on the policy.

[4] More broadly, our study relates to the literature on information avoidance in interpersonal settings, which finds that people may choose ignorance of the impact their actions have on others as an excuse to be more self-serving. See, e.g., Dana et al. (2007); Larson and Capra (2009); Matthey and Regner (2011); Conrads and Irlenbusch (2013); Feiler (2014); Grossman (2014); Thunström et al. (2014); Onwezen and van der Weele (2016) and Grossman and van der Weele (2017). See also Sweeny et al. (2010); Hertwig and Engel (2016) and Golman et al. (2017) for general reviews of the literature on information avoidance,

learn the calorie content of their preferred meal. Subsequently, these subjects (who in their experiment stay uninformed) consume significantly more calories than either subjects who choose to become informed or subjects given the information exogenously. Woolley and Risen (2018) similarly find that 63% of subjects presented with a hypothetical restaurant setting choose not to learn the calorie content of a dessert. They find also that these subjects, when subsequently told the calorie content, are more likely to order the dessert than are subjects who choose to be informed up front.

Although our study resembles Thunström et al.'s (2016) study in some respects, it differs in terms of both theory and experimental design. In terms of theory, Thunström et al. (2016) develop a model in which agents have present-biased preferences, and experience guilt when their ex-post behavior diverges from their ex-ante plans. They show that present-bias is then needed for strategic ignorance to be optimal (since without present-bias, there is no divergence in behavior to feel guilty about), and find empirical support for that prediction. Our study instead follows Brunnermeier and Parker's (2005) baseline model, used also by Oster et al. (2013), in assuming that agents have time-consistent preferences. If, rather than feeling guilty about past behavior, agents feel anxious about future consequences of their behavior, and if they use optimal expectations to reduce that anxiety, then they need not be present-biased for strategic ignorance to be optimal. Empirically, we do not find in this study that individuals with present-biased preferences or low self-control are more likely to ignore information.

As for experimental design, whereas Thunström et al. (2016) only include a control group where subjects are exogenously *informed* about the calorie content in meals, we include a condition where subjects are exogenously *uninformed*. Adding this control group is important for policy analysis: it provides a benchmark for gauging how strategic ignorance might impact the effectiveness of information policies designed to reduce calorie consumption.

Three key results emerge from our study. First, we find that strategic ignorance is a robust phenomenon: 46% of subjects choose to ignore the calorie content of ready meals and use

and Sunstein (2018) for a discussion on welfare effects of information. Hoel et al. (2006) study the welfare effects of genetic testing and information avoidance.

their ignorance strategically—they consume more calories than they would have had they been informed. This percentage is in line with the findings by Thunström et al. (2016) and Woolley and Risen (2018). Second, we find support for the optimal expectations model, i.e., we find that strategic ignorance may be driven by people's ability to, under ignorance, form optimistic beliefs about the probability of their favorite meal being low-calorie. Third, we find that the prevalence of strategic ignorance largely negates the effectiveness of information provision. Offering subjects optional information, i.e., information they can choose to ignore, has no significant effect on their average risky consumption compared to not giving them information at all.

2. A Model of Strategic Ignorance and Optimal Expectations

Our model translates Brunnermeier and Parker's (2005) model of "optimal expectations" to our setting of an agent who receives immediate utility from consuming a meal, while anticipating negative future health consequences that depend on the meal's ex-ante uncertain calorie content.

Let x denote the fraction of the meal that the agent consumes, and $e(x)$ the "enjoyment" that she gains from doing so in the current period 1. Assume $e(0) = 0$, $e'(0) > 0$, and $e''(x) < 0$. Also, let $-f(x)$ denote the negative health consequences from consuming the meal that she will incur in a future period 2 if and only if the meal is high-calorie. Assume $f(0) = 0$, $0 \leq f'(0) < e'(0)$ and $f''(x) \geq 0$.

If the agent is uninformed about the meal's calorie content, then what Brunnermeier and Parker call her "felicity" in period 1 is

$$\widehat{E}U_1 = e(x) - \beta\widehat{p}f(x),$$

where $\widehat{E}$ is the subjective expectations operator associated with the subjective probability $\widehat{p}$ that the meal is high- rather than low-calorie, β is the agent's discount factor, and $\beta\widehat{p}f(x)$ is the agent's *anticipatory* disutility (in the form of anxiety) experienced during period 1 from considering the potential future health consequences if the meal is high-calorie.

The agent chooses x so as to maximize this felicity, with solution $x^n(\widehat{p})$ (superscript "n" for "not informed") given by

$$e'(x^n) - \beta\widehat{p}f'(x^n) = 0. \tag{1}$$

Note that by the Implicit Function Theorem,

$$\frac{dx^n}{d\widehat{p}} = \frac{\overbrace{\beta f'(x^n)}^{(+)}}{\underbrace{e''(x^n) - \widehat{p}\beta f''(x^n)}_{(-)}} < 0, \tag{2}$$

i.e., the higher the subjective probability that the agent places on the meal being high-calorie, the less she consumes.

Given her period-1 choice of x^n, the agent's felicity in period 2 if the meal turns out to be low-calorie is

$$\widehat{E}U_2^{\ell} = e(x^n),$$

and if it turns out to be high-calorie,

$$\widehat{E}U_2^{h} = e(x^n) - \beta f(x^n).$$

In these expressions, $e(x^n)$ is what Brunnermeier and Parker refer to as the agent's "memory utility" from period 1 and $f(x^n)$ is *realized* utility in period 2 if the meal is high-calorie. Since there are only two periods in our setting, there are no subjective expectations to worry about in period 2, so the $\widehat{E}$ operator is actually irrelevant in that period.

Central to Brunnermeier and Parker's theory is the assumption that the agent chooses subjective probability $\widehat{p}$ in period 1 so as to maximize her "well being," which is defined as the expected time average of her felicity. In our two-period setting, her well-being is

$$\mathcal{W}^n = E\left[\tfrac{1}{2}\left(\widehat{E}U_1 + \widehat{E}U_2\right)\right],$$

where E denotes the *objective* expectations operator associated with the *objective* probability p that the meal is high-calorie. Substituting from above yields that

$$\begin{aligned}\mathcal{W}^n &= (1-p)\left[\tfrac{1}{2}\left(\left\{e(x^n) - \beta\widehat{p}f(x^n)\right\} + \left\{e(x^n)\right\}\right)\right] \\ &\qquad + p\left[\tfrac{1}{2}\left(\left\{e(x^n) - \beta\widehat{p}f(x^n)\right\} + \left\{e(x^n) - \beta f(x^n)\right\}\right)\right] \\ &= e(x^n) - \beta\widehat{p}f(x^n) + \tfrac{1}{2}(\widehat{p} - p)\beta f(x^n). \end{aligned} \tag{3}$$

The agent's optimal $\widehat{p}$ therefore solves

$$\max_{\widehat{p}} \mathcal{W}^n = e(x^n) - \beta\widehat{p}f(x^n) + \tfrac{1}{2}(\widehat{p} - p)\beta f(x^n) \quad \text{subject to} \quad \widehat{p} \in [0,1],$$

where $x^n = x^n(\widehat{p})$. Using (1) and (2) yields that the solution is given by first-order condition

$$\frac{\partial \mathcal{W}^n}{\partial \widehat{p}} = -\tfrac{1}{2}\beta f(x^n) + \tfrac{1}{2}\beta(\widehat{p} - p)f'(x^n)\frac{dx^n}{d\widehat{p}} \leq 0, \quad \text{if} <, \text{then } \widehat{p} = 0. \tag{4}$$

Note that the condition can hold with equality only if $\widehat{p} < p$. If the agent chooses not to become informed about the meal's calorie content, she will therefore optimally reduce her subjective probability $\widehat{p}$ that the meal is high-calorie, possibly all the way to zero. The benefit of doing so, captured by the first term of the condition, is that it reduces the agent's subjective, anticipatory disutility in period 1. The cost, however, captured by the second term, is that it increases her future *objective* disutility, through increasing her consumption x^n and thereby worsening expected future health consequences.

Now suppose the agent has the option of learning the meal's calorie content before choosing x. The benefit of doing so is that she can then optimally tailor their consumption level to the calorie level. The cost, however, is that she can no longer choose subjective probability $\widehat{p}$ so as to modify her anticipatory disutility.

More specifically, when considering the option to become informed, the agent will realize that, if she learns that the meal is low-calorie, her period-1 felicity will just equal her enjoyment of the meal,

$$U_1 = e(x).$$

Her optimal choice x^{ih} (superscript "ih" for "informed that the meal is healthy") will therefore be given by

$$e'(x^{ih}) = 0. \tag{5}$$

As a result, her period-2 felicity will be the memory utility from that enjoyment,

$$U_2 = e(x^{ih}).$$

If, in contrast, she learns that the meal is high-calorie, her period-1 felicity will be

$$U_1 = e(x) - \beta f(x),$$

since she will anticipate the negative health consequences of her consumption. Her optimal choice x^{iu} (superscript "iu" for "informed that the meal is unhealthy") will be given by

$$e'(x^{iu}) - \beta f'(x^{iu}) = 0, \tag{6}$$

and her period-2 felicity will equal the memory utility from her enjoyment less the realized health consequences,

$$U_2 = e(x^{iu}) - \beta f(x^{iu}).$$

Combining the two possible outcomes, we have that the agent's ex-ante well-being if she becomes informed is

$$\mathcal{W}^i = E\left[\tfrac{1}{2}\left(U_1 + U_2\right)\right] = (1-p)e(x^{ih}) + p\left[e(x^{iu}) - \beta f(x^{iu})\right]. \tag{7}$$

The agent's decision whether to stay ignorant or become informed depends on the comparison between $\mathcal{W}^n$ and $\mathcal{W}^i$. Which of the two is larger, and hence whether the agent chooses to become informed when given the opportunity, will depend on parameters. Specifically, if we make the simplifying assumption that both consumption benefits $e(x)$ and costs $f(x)$ are close to quadratic (so third-order effects can be ignored), we obtain the following results:[5]

[5] The Proposition is analogous to Oster et al.'s (2013) Proposition 3, which shows that testing for Huntington disease is optimal only for individuals who place low weight on anticipated utility.

Proposition. *If agents are heterogeneous in terms of the weight β that they place on future consequences of calorie consumption, and some choose to become informed while others choose to remain ignorant, it is agents with low β who will choose ignorance.*

Corollary. *Except for an extreme case in which all agents place zero subjective probability $\widehat{p}$ on future health consequences under ignorance, agents who self-select into ignorance will have more optimistic expectations (i.e., lower $\widehat{p}$) and higher consumption levels than agents who are forced to be uninformed.*

The proof of both results is lengthy, and relegated to a mathematical appendix. The underlying intuition is straightforward, however. Agents with high discount factor β care relatively less about the immediate benefit of ignorance in terms of reducing anticipatory disutility, and relative more about the future cost in terms of potentially worse health outcomes; they are therefore more likely to choose to become informed. Moreover, if becoming informed is not an option, agents with high β are more likely to keep their optimism and consumption in check, to avoid negative health consequences.

3. Experimental Design

We recruited 201 subjects from the general population in the Copenhagen area to participate in an hour-long experiment session during lunch time (starting at noon). Participants were paid DKK 300 (around USD 50). When recruited to the experiment, the subjects were told that they should not eat lunch before the experiment session.

Our experimental design builds on that in Thunström et al. (2016). The experiment uses ready meals as the risky good. Ready meals are ideal for our purposes, since they are fairly transparent in immediate pleasure (taste), but non-transparent in future harm (calories).[6] Ready meals thus provide scope for ignoring information about the harm from consumption.

All subjects were offered a choice between two meals: chicken with salad and pasta (500 calories), or roast beef with salad and quinoa (890 calories). Subjects were informed that

[6] Most people find it difficult to guess the calorie content of ready meals; see Burton et al. (2006).

one of the meals was high-calorie and the other meal low-calorie, and were told the specific calorie numbers, but not initially which meal was which.[7] The two meals were placed on the desk in front of each subject together with a pitcher of water. The desks had dividers, so that subjects were unable to see each other's meal choices, or how much of the meals others consumed.

The experiment was conducted in seven steps:

Step 1: Subjects rated the expected taste of both meals (1=very bad, 5=very good).

Step 2: Subjects chose their preferred meal.

Step 3: The 96 subjects in the treatment group were given the opportunity to learn the meals' calorie content by choosing to open an envelope containing that information. If they did not want to know the calorie content of the meals, they opened another envelope that contained an empty sheet of paper. The 53 subjects in the control informed group were told the meals' calorie content both verbally and on paper. The 52 subjects in the control uninformed group were told nothing about the specific meals' calorie content.

Step 4: Subjects in the treatment and control informed groups were offered the opportunity to revise their meal choice.

Step 5: Subjects in the control informed and control uninformed groups were asked if they would have avoided/taken calorie information had they had the opportunity to do so.

Step 6: The meal not chosen by the subject was removed from the subject's desk and subjects finished their meal while answering survey questions pertaining to self-control, risk preferences, health concern, exercise, and socio-demographics.

Step 7: Subjects were weighed and measured, and their leftover food weighed to determine their calorie consumption.

[7] Telling subjects the specific calorie numbers is an important design feature of the experiment, because people tend to underestimate the amount of calories in ready meals, even if they do not anticipate consuming those meals (Burton et al., 2006; Chandon and Wansink, 2007). Our design preempts this tendency, while still leaving scope for 'optimal expectations' behavior: subjects who choose not to find out which meal is which can downplay the probability of their preferred meal being high-calorie.

Table 1. Descriptive statistics, full sample

	Mean	SD	Min	Max
Self-control	57.71	9.97	35.0	88.2
Risk aversion (CRRA)	0.90	1.10	0.025	3.90
Health concern	4.09	1.38	1	7
Sports (hours/week)	2.02	2.85	0	21
Female	0.50	0.50	0	1
Age	45.46	13.42	19	66
Above-ave. income	0.52	0.50	0	1
Some college	0.68	0.47	0	1

For descriptive statistics on variables collected from the experiment, see Tables 1 and 2. To assess self-control, we used the brief self-control scale in Tangney et al. (2004). Items coded negatively (so that a high score indicates low self-control) on that scale were recoded positively, so that the final measure ranges from 13 (very low self-control) to 91 (very high self-control). To assess risk preferences, we used the incentivized measure developed by Eckel and Grossman (2008) to estimate subjects' coefficient of relative risk aversion (CRRA). Health concern was measured on a Likert scale indicating agreement with the statement "I care a lot how healthy food is" (1=totally disagree, 7=totally agree). The last two columns of Table 2 show that in terms of demographics or other characteristics, treatment group subjects do not differ significantly from control group subjects.

4. Empirical Results

4.1. *Evidence of ignorance being strategic*

As shown in Table 3, 46% of the subjects in the treatment group chose to ignore the calorie information. In the standard expected-utility model, without optimal expectations, agents would choose to ignore costless information only if they anticipate that learning the information would not change their behavior, making them exactly indifferent about learning it or not. The implication is that, if information were given to these agents exogenously, their behavior would not change. The most straightforward way to determine if the treatment

Table 2. Descriptive statistics, by group

	Treatment		Control inf		Control uninf		T-Ci	T-Cu
	Mean	SD	Mean	SD	Mean	SD	t-test	t-test
Self-control	58.17	10.32	59.45	10.14	55.17	8.75	(−0.72)	(1.78)*
Risk aversion (CRRA)	0.89	1.10	0.75	1.01	1.07	1.20	(0.79)	(−0.90)
Health concern	4.06	1.41	4.13	1.46	4.12	1.28	(−0.30)	(−0.26)
Sports (hours/week)	2.29	3.36	2.24	2.59	1.31	1.83	(0.09)	(1.92)*
Female	0.47	0.50	0.57	0.50	0.50	0.50	(−1.13)	(−0.36)
Age	45.38	13.66	44.87	14.10	46.21	12.43	(0.21)	(−0.37)
Above-ave. income	0.50	0.50	0.55	0.50	0.51	0.51	(−0.59)	(−0.12)
Some college	0.62	0.49	0.72	0.45	0.73	0.45	(−1.13)	(−1.30)

Notes: T-Ci = Treatment - Control informed, T-Cu = Treatment - Control uninformed
* $p<0.10$, ** $p<0.05$, *** $p<0.01$

group subjects' voluntary ignorance is consistent with standard expected-utility theory is therefore to compare their consumption to that of control informed subjects who, had they been given the option, would have chosen ignorance as well.

If we use the answers provided in Step 5 of the experiment to perform this analysis, we find strong evidence that voluntary ignorance results not from indifference, but is strategic: subjects who chose to ignore calorie information in the treatment group (44 subjects) consumed on average 501 calories, while subjects in the control informed group who claimed they would have ignored information (10 subjects) consumed on average 301 calories. A two-tailed t-test rejects equality of these values ($p = 0.018$). However, the share of control informed subjects who claimed they would have chosen ignorance (10/53, i.e., 19%) is substantially lower than that of treatment subjects who actually chose ignorance (44/96, i.e., 46%). We therefore perform additional analysis, using the same approach as Thunström et al. (2016). We focus thereby on "beef lovers"—subjects who initially, in Step 2 of the experiment, chose the high-calorie meal, and were therefore most likely to respond to information revealing that fact by either reducing their consumption of the beef meal or switching to the lower-calorie chicken meal.

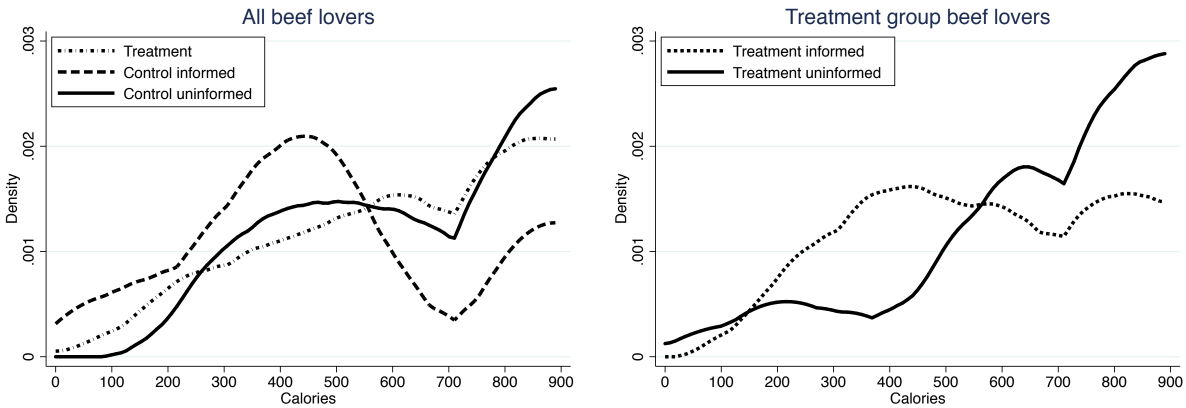
Panel (a) of Figure 1 shows kernel density estimates of ultimate calorie consumption by beef lovers in all three experimental groups. The figure indicates a clear shift towards higher

Table 3. Average calorie consumption, by group

	N	Calories
All	201	480
Treatment	96	495
chose info	52 (54%)	491
chose no info	44 (46%)	501
Control informed	53	400
would have chosen info	43 (81%)	423
would have chosen no info	10 (19%)	301
Control uninformed	52	532
Beef lovers	121	565
Treatment	59	585
chose info	34 (58%)	544
chose no info	25 (42%)	642
Control informed	26	458
Control uninformed	36	608
Chicken lovers	80	351
Treatment	37	352
chose info	18 (49%)	390
chose no info	19 (51%)	315
Control informed	27	345
Control uninformed	16	360

consumption when beef-loving subjects are allowed to ignore calorie information (because they are in the treatment group), compared to when they are given the information exogenously (because they are in the control informed group). This shift is confirmed by a Kolmogorov-Smirnov (KS) test for equality of the treatment and control informed distributions, which strongly rejects the null of equality ($p = 0.011$). Similarly, a two-tailed t-test comparing average calorie consumption across the two groups—585 for treatment group beef lovers vs. 458 for control informed ones—strongly rejects the null of equal means ($p = 0.022$).

Panel (b) of the figure indicates, moreover, that the overall higher consumption by treatment-group beef lovers is driven by subjects in that group who chose ignorance; those who chose to learn the calorie information consume about the same as subjects given information exogenously, i.e., the control informed subjects in panel (a). This is confirmed by a KS test, which fails to reject equality of the treatment informed and control informed subjects'



(a) (b)

Figure 1. Calorie consumption of (a) all beef lovers and (b) treatment group beef lovers.

Table 4. Subjects' estimates of calories in their chosen meal

	Treatment uninf			Control uninf			Tu-Cu	Tu-Cu
	N	Mean	SD	N	Mean	SD	t-test	WMW test
All subjects	35	550	234	50	650	198	$(-2.13)^{**}$	$(-2.361)^{***}$
Beef lovers	20	540	212	36	635	187	$(-1.73)^{**}$	$(-2.220)^{**}$
Chicken lovers	15	563	268	14	689	227	$(-1.36)^{*}$	(-1.259)

Notes: Tu-Cu = Treatment uninformed - Control informed, WMW = Wilcoxon-Mann-Whitney
* $p<0.10$, ** $p<0.05$, *** $p<0.01$

calorie consumption distributions ($p = 0.183$). Similarly, a two-tailed t-test comparing the two groups' average calorie consumption levels—544 for treatment informed beef lovers vs. 458 for control informed ones—fails to rejects the null of equal means ($p = 0.143$).

These results provide support for the prevalence of strategic ignorance, confirming the findings in Thunström et al. (2016).

4.2. *Evidence on ignorance being motivated by 'optimal expectations'*

To investigate whether the observed voluntary ignorance of treatment group subjects might be motivated by the ability to then form optimal expectations about risk (future health costs), subjects were asked how many calories they thought were contained in the meal they consumed. As shown in Table 4, the average estimate of subjects in the treatment uninformed group was 550 calories, while that for subjects in the control uninformed group was 650 calories. We also break down the data by beef lovers and chicken lovers, i.e., subjects who chose the beef salad or the chicken salad in Step 2 of the experiment.[8] Estimates by beef lovers and chicken lovers considered separately were similar. Importantly, the finding that these estimates are below the average ($\frac{1}{2}(500 + 890) = 695$) calorie content of the two meals need in itself not imply that these subjects engaged in optimal expectations. Rather, it may reflect some heterogeneity in the prior probability that subjects placed on which meal was high-calorie, combined with a general tendency to prefer low-calorie meals.

Any significant difference between the treatment and control groups' estimates does provide evidence that optimal expectations were at play, however. The reason is that in the standard expected-utility model, the prior probability that treatment group subjects place on which meal was high-calorie would be immaterial to their decision whether to become informed or not.[9] As a result, one would expect both the treatment uninformed and control uninformed groups to have the same distribution of priors, and thereby the same average estimate of their chosen meal's calorie content.

In contrast, if optimal expectations do play a role, then our analysis in Section 2 shows that one should expect calorie estimates to differ across the two groups. Our Corollary result implies that if subjects are heterogeneous in terms of the weight they place on future health consequences, then subjects in the treatment group who self-select into ignorance should on average downplay the future health costs by more than subjects in the control uninformed group. This is because the control uninformed group includes subjects who, if given the opportunity, would have self-selected into being informed, and these are subjects whose tendency to downplay future health costs is comparatively low.

As shown in the next-to-last column of Table 4, a one-tailed t-test rejects the null of equal means in favor of the alternative hypothesis suggested by the Corollary, namely that the mean

[8] The subsample sizes shown differ slightly from those in Table 3, because not all subjects answered the question.

[9] Subjects would choose to become informed if their priors placed any weight at all on a state of the world in which information might change their optimal behavior; the magnitude of that weight would be irrelevant. Conversely, subjects would be indifferent about information, and thus might choose to remain ignorant, if learning the state of the world would not change their behavior anyway; but then their priors on either state of the world obtaining would be irrelevant also.

estimate of treatment uninformed subjects will be lower than that of control uninformed ones (the p-values for the three rows are 0.018, 0.044, and 0.092).

A caveat to this finding is that quite a few subjects gave estimates that differed from either 500 or 890 calories. As mentioned in the description of the experimental design above, all subjects were told up front that those were the calorie contents of the two meals on offer, whereby uninformed subjects never learned which meal was which. Subjects who gave different estimates must therefore have not paid careful attention to the exact calorie numbers, or have forgotten those numbers by the time they were asked for their estimate (towards the end of the experiment).

Figure 2 shows the distribution of estimates given by the treatment uninformed and control uninformed subgroups, both as histograms and as kernel density estimates. In all six panels, there is a tendency for the treatment uninformed subjects' distribution to be shifted leftwards relative to that of control uniformed subjects. This impression is confirmed by one-tailed Wilcoxon-Mann-Whitney tests. As shown in the last column of Table 4, both for the full sample and the subsample of beef lovers, these tests reject the null of equal distributions in favor of the alternative hypothesis that the distribution for control informed subjects stochastically dominates that of treatment uninformed ones (the p-values for the three rows are 0.009, 0.013, and 0.104).[10]

4.3. *Evidence on ignorance negating the impact of health risk information*

We next turn to the important question of how the prevalence of strategic ignorance might impact the effectiveness of information policies designed to reduce risky (here, calorie) consumption. To answer this question, we compare calorie consumption when subjects have no access to information (i.e., control uninformed subjects) to calorie consumption when

[10] Since we collected data pertaining to self-control, risk preferences, health concern, exercise, and socio-demographics, we also examined how these variables may impact the choice of ignorance. We find robustly that women and people who are more concerned with their health are less likely to choose ignorance. Certain model specifications also imply that self-control affects the choice of ignorance. However, our results on the determinants of ignorance are so sensitive to model specification that we refrain from reporting them.

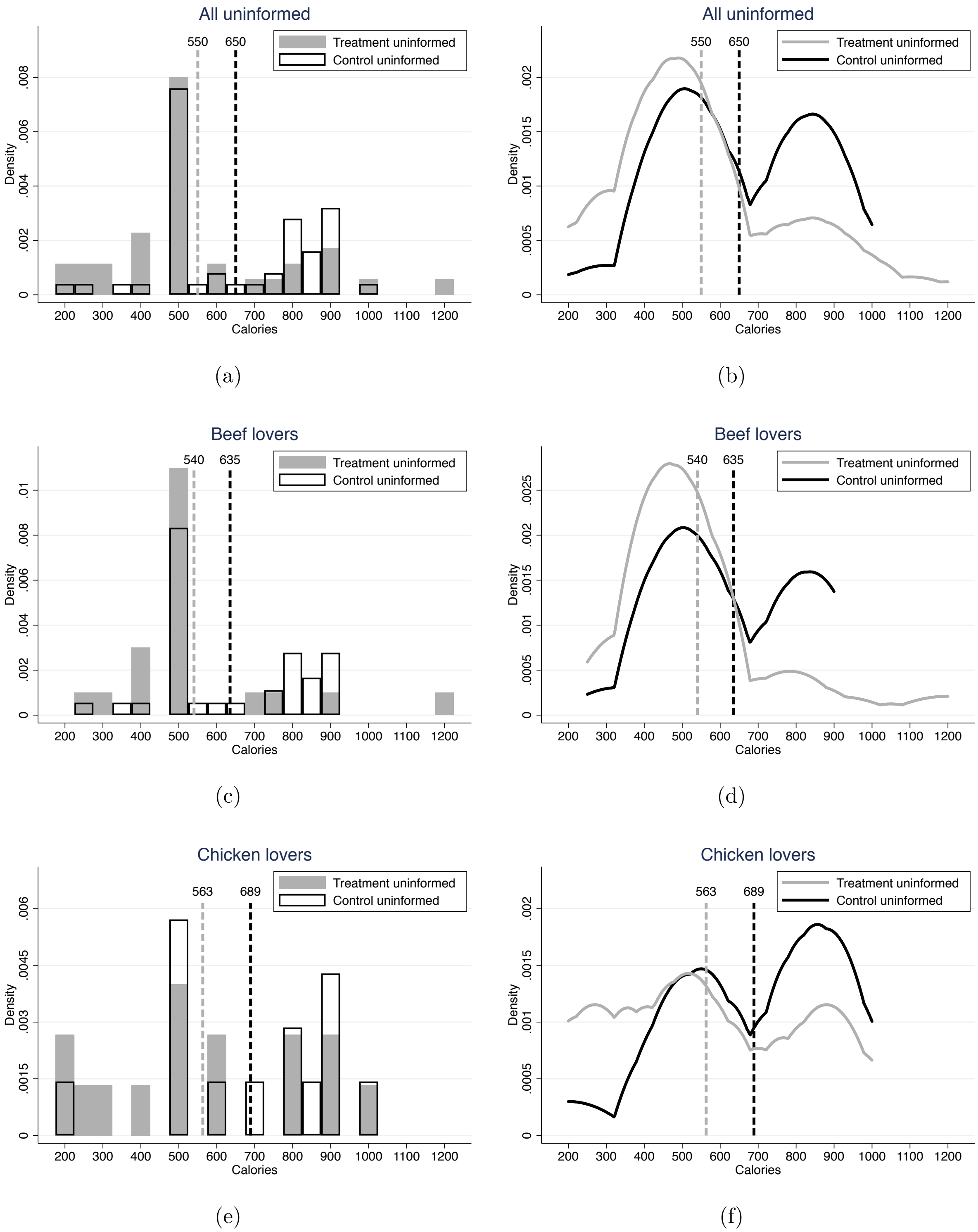


Figure 2. Comparison of the distribution of treatment uninformed and control uninformed subjects' estimates of calories in their chosen meal.

subjects are provided information, but can choose either to take it or ignore it (i.e., treatment group subjects).

Panel (a) of Figure 1 shows the distribution of calorie consumption for beef lovers in these two groups (as well as in the control informed group). Providing risk information that subjects can choose to ignore seems to have no impact on risk behavior: a KS test fails to reject the null of equal distributions for the control uninformed and treatment groups ($p = 0.862$), and a two-tailed t-test comparing average calorie consumption across the two groups—608 for control uninformed beef lovers vs. 585 for treatment group ones—fails to reject the null of equal means ($p = 0.619$).

The same finding applies also when comparing consumption of all subjects, i.e., beef and chicken lovers combined. A KS test fails to reject the null of equal distributions of calorie consumption for the control uninformed group as a whole and the treatment group as a whole ($p = 0.614$), and a two-tailed t-test comparing their average calorie consumption—532 for all control uninformed subjects vs. 495 for all treatment group ones—fails to reject the null of equal means ($p = 0.327$).

In contrast, our findings indicate that if all subjects were forced to take the risk information provided, the policy *would* have a strong and significant impact on calorie consumption. A KS test rejects the null of equal distributions of calorie consumption for control informed and control uninformed beeflovers ($p = 0.030$), and a two-tailed t-test comparing average calorie consumption for the two groups (458 and 608) strongly rejects equality ($p = 0.012$). For the two groups taken as a whole, the rejections are even stronger ($p = 0.010$ and $p = 0.001$, respectively). These results suggest that the prevalence of strategic ignorance may entirely negate the impact on risky consumption from a policy that entails risk information provision.

5. Conclusion

Our study contains mixed news for advocates of information-based policies as a form of "soft" paternalism (Thaler and Sunstein, 2008; Hector, 2012). The good news is that about half of our subjects chose to learn calorie information and responded to that information appropriately—on average, they cut back their calorie consumption, thereby reducing their long-term overweight and obesity health risks. On the other hand, about half chose to ignore the calorie information and failed to cut back their consumption.

Whether this voluntary ignorance should be seen as bad news depends on policy objectives. If the goal is to change risk outcomes, then clearly the second sub-group's behavior is undesirable, and possibly calls for "hard" paternalistic measures such as taxes or reduced choice sets of risky consumption (e.g., mandatory product reformulations). If the goal is to maximize welfare, however, then matters are more complex.

We find that, consistent with Brunnermeier and Parker's (2005) theory of optimal expectations, subjects who chose to ignore calorie information subsequently downplayed the risk of their consumption being harmful. According to the theory, this behavior need not be suboptimal. To the contrary, it may maximize utility, by optimally balancing reduced immediate anxiety against increased future health costs (risks). Moreover, it may be optimal not just ex ante, but also ex post, i.e., without giving rise to regret.

If this indeed explains the behavior of the second sub-group of subjects, then the optimal policy may paradoxically be to *accommodate* strategic ignorance, through providing information that is easy to ignore. Counteracting strategic ignorance, for example by placing hard-to-ignore "traffic light" nutrition labels on the front of food packaging (Hawley et al., 2012; Emrich et al., 2017), will only reduce welfare, by essentially taking away consumers' ability to engage in optimal self-deception.

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Appendix

Proof of the Proposition.

For convenience, we repeat the key equations of the model laid out in the paper, namely the condition that implicitly defines x^n,

$$e'(x^n) - \widehat{p}\beta f'(x^n) = 0, \tag{1}$$

and its implied derivative w.r.t. $\widehat{p}$,

$$\frac{dx^n}{d\widehat{p}} = \frac{\beta f'(x^n)}{e''(x^n) - \beta\widehat{p}f''(x^n)}, \tag{2}$$

the expression for $\mathcal{W}^n$,

$$\mathcal{W}^n = e(x^n) - \widehat{p}\beta f(x^n) + \tfrac{1}{2}(\widehat{p} - p)\beta f(x^n), \tag{3}$$

and its implied first-order condition for $\widehat{p}$,

$$\frac{\partial \mathcal{W}^n}{\partial \widehat{p}} = -\tfrac{1}{2}\beta f(x^n) - \tfrac{1}{2}(p - \widehat{p})\beta f'(x^n)\frac{dx^n}{d\widehat{p}} \leq 0, \quad \text{if } <, \text{ then } \widehat{p} = 0, \tag{4}$$

the two conditions that implicitly define x^{ih} and x^{iu},

$$e'(x^{ih}) = 0, \tag{5}$$

$$e'(x^{iu}) - \beta f'(x^{iu}) = 0, \tag{6}$$

and lastly the expression for $\mathcal{W}^i$,

$$\mathcal{W}^i = (1 - p)e(x^{ih}) + p\left[e(x^{iu}) - \beta f(x^{iu})\right]. \tag{7}$$

The proof proceeds by establishing the following two results:

(i) At $\beta = 0$, $\mathcal{W}^n = \mathcal{W}^i$ and $\partial\mathcal{W}^n/\partial\beta > \partial\mathcal{W}^i/\partial\beta$.

(ii) For quadratic $e(x)$ and $f(x)$, at any β^* where $\mathcal{W}^n = \mathcal{W}^i$, $\partial\mathcal{W}^i/\partial\beta > \partial\mathcal{W}^n/\partial\beta$.

Result (i) implies, by continuity, that at positive but sufficiently small values of β, $\mathcal{W}^i$ lies strictly below $\mathcal{W}^n$. Result (ii) implies that if $\mathcal{W}^i$ ever climbs above $\mathcal{W}^n$ at a higher value of β—which is easily shown by example to be possible—then it will stay above $\mathcal{W}^n$ up to $\beta = 1$. The two results combined imply the Proposition.

Result (i): To establish that at $\beta = 0$, $\mathcal{W}^n = \mathcal{W}^i$, note that at $\beta = 0$, conditions (1), (5), and (6) imply that $x^n = x^{ih} = x^{iu}$, and expressions (3) and (7) as a result reduce to $\mathcal{W}^n = \mathcal{W}^i = e(x^{ih})$.

To establish that at $\beta = 0$, $\partial \mathcal{W}^n / \partial \beta > \partial \mathcal{W}^i / \partial \beta$, note from first-order condition (4) for $\widehat{p}$ that the corner solution $\widehat{p} = 0$ arises at values of β such that

$$-\tfrac{1}{2}\beta f(x^n) - \tfrac{1}{2}p\beta f'(x^n)\frac{dx^n}{d\widehat{p}} < 0$$

or, solving for β and using that $x^n = x^{ih}$ at $\widehat{p} = 0$, at

$$\beta < \frac{-e''(x^{ih})f(x^{ih})}{p[f'(x^{ih})]^2} \equiv \beta^c.$$

At these values of β, $\mathcal{W}^n$ reduces to

$$\mathcal{W}^n = e(x^{ih}) - \tfrac{1}{2}p\beta f(x^{ih}),$$

so

$$\frac{\partial \mathcal{W}^n}{\partial \beta} = -\tfrac{1}{2}pf(x^{ih}).$$

Meanwhile, differentiating $\mathcal{W}^i$ w.r.t. β and using the envelope theorem yields

$$\frac{\partial \mathcal{W}^i}{\partial \beta} = -pf(x^{iu}).$$

Using again that $x^{ih} = x^{iu}$ at $\beta = 0$, it follows that

$$\left.\frac{\partial \mathcal{W}^n}{\partial \beta}\right|_{\beta=0} = -\tfrac{1}{2}pf(x^{ih}) > -pf(x^{ih}) = \left.\frac{\partial \mathcal{W}^i}{\partial \beta}\right|_{\beta=0}.$$

Result (ii): Before turning to the implications of $e(x)$ and $f(x)$ being quadratic, it is useful to show that when $\beta > \beta^c$, so that $\widehat{p} > 0$, differentiating $\mathcal{W}^n$ w.r.t. β and using the envelope theorem yields

$$\begin{aligned}
\frac{\partial \mathcal{W}^n}{\partial \beta} &= -\widehat{p}f(x^n) - \tfrac{1}{2}(p - \widehat{p})\left\{f(x^n) + \beta f'(x^n) \cdot \frac{dx^n}{d\beta}\right\} \\
&= -\widehat{p}f(x^n) - \tfrac{1}{2}(p - \widehat{p})\left\{f(x^n) + \beta f'(x^n) \cdot \frac{\widehat{p}}{\beta}\frac{dx^n}{d\widehat{p}}\right\} \\
&= -\tfrac{1}{2}pf(x^n) - \tfrac{1}{2}\widehat{p}\underbrace{\left[f(x^n) + (p - \widehat{p})f'(x^n) \cdot \frac{dx^n}{d\widehat{p}}\right]}_{=0} \\
&= -\tfrac{1}{2}pf(x^n).
\end{aligned}$$

The second step of this derivation uses that, from (1) and (2),

$$\frac{dx^n}{d\beta} = \frac{\widehat{p}f'(x^n)}{e''(x^n) - \widehat{p}\beta f''(x^n)} = \frac{\widehat{p}}{\beta}\frac{dx^n}{d\widehat{p}},$$

and the final step uses first-order condition (4). Since we showed above that when $\beta \leq \beta^c$, $x^n = x^{ih}$ and $\partial \mathcal{W}^n / \partial \beta = -\frac{1}{2} p f(x^{ih})$, it follows that for all β

$$\frac{\partial \mathcal{W}^n}{\partial \beta} = -\tfrac{1}{2} p f(x^n). \tag{8}$$

If now $e(x)$ is quadratic, of the form $Ax - \frac{1}{2}Bx^2$, then our assumptions about $e(x)$ require that $A > 0$ and $B > 0$. Similarly, if $f(x)$ is quadratic, of the form $Cx + \frac{1}{2}Dx^2$, our assumptions require that $C \geq 0$ and $D \geq 0$, with C and D not both zero. To simplify notation, define $a \equiv A/B$, $b \equiv B/(\beta D)$, and $c \equiv C/D$, and also define $x \equiv x^{iu}$, $y \equiv x^n$, and $z \equiv x^{ih}$.

Preliminaries: With this notation, condition

$$e'(x^{iu}) - \beta f'(x^{iu}) = 0 \tag{6}$$

becomes

$$A - Bx - \beta[C + Dx] = 0,$$

so that

$$x \equiv x^{iu} = \frac{A - \beta C}{B + \beta D} = \frac{\dfrac{A}{B}\dfrac{B}{\beta D} - \dfrac{C}{D}}{\dfrac{B}{\beta D} + 1} = \frac{ab - c}{b + 1},$$

$$c + x = \frac{b(a + c)}{b + 1}, \tag{9}$$

and

$$a - x = \frac{a + c}{b + 1} = \frac{1}{b}(c + x). \tag{10}$$

Similarly, condition

$$e'(x^n) - \widehat{p}\beta f'(x^n) = 0, \tag{1}$$

becomes

$$A - By - \widehat{p}\beta[C + Dy] = 0,$$

so that

$$y \equiv x^n = \frac{A - \widehat{p}\beta C}{B + \widehat{p}\beta D} = \frac{\dfrac{A}{B}\dfrac{B}{\beta D} - \widehat{p}\dfrac{C}{D}}{\dfrac{B}{\beta D} + \widehat{p}} = \frac{ab - \widehat{p}c}{b + \widehat{p}},$$

and therefore

$$c + y = \frac{b(a + c)}{b + \widehat{p}}. \tag{11}$$

Combining (9) and (11) gives

$$\frac{c+x}{c+y} = \frac{b+\widehat{p}}{b+1}. \tag{12}$$

Lastly, condition

$$e'(x^{ih}) = 0, \tag{5}$$

becomes

$$A - Bz = 0,$$

so that

$$z \equiv x^{ih} = \frac{A}{B} = a.$$

Using these preliminaries, we are to show that if at some $\beta^* > 0$

$$\mathcal{W}^i = \mathcal{W}^n,$$

then at that β^*, the following "slope inequality" holds:

$$\frac{\partial \mathcal{W}^i}{\partial \beta} > \frac{\partial \mathcal{W}^n}{\partial \beta}.$$

Note first that, using result (8) above, the slope inequality can be rewritten as follows:

$$\begin{aligned}
& -pf(x^{iu}) > -\tfrac{1}{2}pf(x^n) \\
\Leftrightarrow \quad & 2f(x^{iu}) < f(x^n) \\
\Leftrightarrow \quad & 2Cx^{iu} + D(x^{iu})^2 < Cx^n + \tfrac{1}{2}D(x^n)^2 \\
\Leftrightarrow \quad & 2\frac{C}{D}x^{iu} + (x^{iu})^2 < \frac{C}{D}x^n + \tfrac{1}{2}(x^n)^2 \\
\Leftrightarrow \quad & 2cx + x^2 < cy + \tfrac{1}{2}y^2 \\
\Leftrightarrow \quad & c^2 + 2cx + x^2 < \tfrac{1}{2}c^2 + cy + \tfrac{1}{2}y^2 + \tfrac{1}{2}c^2 \\
\Leftrightarrow \quad & (c+x)^2 < \tfrac{1}{2}(c+y)^2 + \tfrac{1}{2}c^2 \\
\Leftrightarrow \quad & \left(\frac{c+x}{c+y}\right)^2 < \tfrac{1}{2} + \tfrac{1}{2}\left(\frac{c}{c+y}\right)^2 \\
\Leftrightarrow \quad & \left(\frac{b+\widehat{p}}{b+1}\right)^2 < \tfrac{1}{2}\left[1 + \left(\frac{c}{c+y}\right)^2\right],
\end{aligned} \tag{13}$$

where the final step uses (12).

Consider now first values of $\beta \in (0, \beta^c]$, where $\widehat{p} = 0$. At such values, we can rewrite $\mathcal{W}^n$ as

$$\mathcal{W}^n = e(x^{ih}) - \tfrac{1}{2}p\beta f(x^{ih})$$

$$
\begin{aligned}
&= \left[Ax^{ih} - \tfrac{1}{2}B(x^{ih})^2\right] - \tfrac{1}{2}p\beta\left[Cx^{ih} + \tfrac{1}{2}D(x^{ih})^2\right] \\
&= B\left\{\left[\frac{A}{B}x^{ih} - \tfrac{1}{2}(x^{ih})^2\right] - \tfrac{1}{2}p\frac{\beta D}{B}\left[\frac{C}{D}x^{ih} + \tfrac{1}{2}(x^{ih})^2\right]\right\} \\
&= B\Big\{(az - \tfrac{1}{2}z^2) - \frac{p}{2b}(cz + \tfrac{1}{2}z^2)\Big\}.
\end{aligned}
$$

We can also rewrite $\mathcal{W}^i$ as

$$
\begin{aligned}
\mathcal{W}^i &= (1-p)e(x^{ih}) + p\left[e(x^{iu}) - \beta f(x^{iu})\right] \\
&= (1-p)\left[Ax^{ih} - \tfrac{1}{2}B(x^{ih})^2\right] + p\left[Ax^{iu} - \tfrac{1}{2}B(x^{iu})^2\right] - p\beta\left[Cx^{iu} + \tfrac{1}{2}D(x^{iu})^2\right] \\
&= B\left\{(1-p)\left[\frac{A}{B}x^{ih} - \tfrac{1}{2}(x^{ih})^2\right] + p\left[\frac{A}{B}x^{iu} - \tfrac{1}{2}(x^{iu})^2\right] - p\frac{\beta D}{B}\left[\frac{C}{D}x^{iu} + \tfrac{1}{2}(x^{iu})^2\right]\right\} \\
&= B\Big\{(1-p)(az - \tfrac{1}{2}z^2) + p(ax - \tfrac{1}{2}x^2) - \frac{p}{b}(cx + \tfrac{1}{2}x^2)\Big\}
\end{aligned}
$$

Equating the two expressions then gives

$$
\begin{aligned}
&& \mathcal{W}^i &= \mathcal{W}^n \\
\Leftrightarrow && (1-p)(az - \tfrac{1}{2}z^2) + p(ax - \tfrac{1}{2}x^2) - \frac{p}{b}(cx + \tfrac{1}{2}x^2) &= (az - \tfrac{1}{2}z^2) - \frac{p}{2b}(cz + \tfrac{1}{2}z^2) \\
\Leftrightarrow && p(ax - \tfrac{1}{2}x^2) - \frac{p}{b}(cx + \tfrac{1}{2}x^2) &= p(az - \tfrac{1}{2}z^2) - \frac{p}{2b}(cz + \tfrac{1}{2}z^2) \\
\Leftrightarrow && (ax - \tfrac{1}{2}x^2) - \frac{1}{b}(cx + \tfrac{1}{2}x^2) &= (az - \tfrac{1}{2}z^2) - \frac{1}{2b}(cz + \tfrac{1}{2}z^2) \\
\Leftrightarrow && (-\tfrac{1}{2}a^2 + ax - \tfrac{1}{2}x^2) - \frac{1}{b}(\tfrac{1}{2}c^2 + cx + \tfrac{1}{2}x^2 - \tfrac{1}{2}c^2) &= (-\tfrac{1}{2}a^2 + az - \tfrac{1}{2}z^2) \\
&& &\quad - \frac{1}{2b}(\tfrac{1}{2}c^2 + cz + \tfrac{1}{2}z^2 - \tfrac{1}{2}c^2) \\
\Leftrightarrow && -\tfrac{1}{2}(a-x)^2 - \frac{1}{2b}[(c+x)^2 - c^2] &= -\tfrac{1}{2}(a-z)^2 - \frac{1}{4b}[(c+z)^2 - c^2] \\
\Leftrightarrow && b(a-x)^2 + [(c+x)^2 - c^2] &= b(a-z)^2 + \tfrac{1}{2}[(c+z)^2 - c^2] \\
\Leftrightarrow && b(a-x)^2 + (c+x)^2 &= \tfrac{1}{2}[(c+a)^2 + c^2].
\end{aligned}
$$

Using (10), this can be rewritten further as

$$
\begin{aligned}
&& \frac{1}{b}(c+x)^2 + (c+x)^2 &= \tfrac{1}{2}[(c+a)^2 + c^2] \\
\Leftrightarrow && \frac{b+1}{b}(c+x)^2 &= \tfrac{1}{2}[(c+a)^2 + c^2] \\
\Leftrightarrow && \frac{b+1}{b}\left(\frac{c+x}{c+a}\right)^2 &= \tfrac{1}{2}\left[1 + \left(\frac{c}{c+a}\right)^2\right]
\end{aligned}
$$

$$\Leftrightarrow \qquad \frac{b+1}{b}\left(\frac{b}{b+1}\right)^2 = \tfrac{1}{2}\left[1+\left(\frac{c}{c+a}\right)^2\right]$$

$$\Leftrightarrow \qquad \frac{b}{b+1} = \tfrac{1}{2}\left[1+\left(\frac{c}{c+a}\right)^2\right]. \tag{14}$$

Meanwhile, at $\widehat{p}=0$ and thereby $y=x^n=a$, the rewritten slope inequality (13) reduces to

$$\left(\frac{b}{b+1}\right)^2 < \tfrac{1}{2}\left[1+\left(\frac{c}{c+a}\right)^2\right]. \tag{15}$$

Clearly, (14) implies (15), since $b/(b+1)$ is a fraction. This establishes Result (ii) for $\beta \in (0, \beta^c]$.

Consider next values of $\beta \in (\beta^c, 1]$, where $\widehat{p} > 0$. At these values, first-order condition (4) becomes

$$f(x^n) + (p-\widehat{p})f'(x^n)\frac{dx^n}{d\widehat{p}} = 0,$$

which can be rewritten as

$$\begin{aligned}
& Cx^n + \tfrac{1}{2}D(x^n)^2 + (p-\widehat{p})(C+Dx^n)\cdot -\beta\frac{C+Dx^n}{B+\widehat{p}\beta D} = 0 \\
\Leftrightarrow\quad & (B+\widehat{p}\beta D)\left(Cx^n + \tfrac{1}{2}D(x^n)^2\right) - (p-\widehat{p})\beta(C+Dx^n)^2 = 0 \\
\Leftrightarrow\quad & \left(\frac{B}{\beta D}+\widehat{p}\right)\left(\frac{C}{D}x^n + \tfrac{1}{2}(x^n)^2\right) - (p-\widehat{p})\left(\frac{C}{D}+x^n\right)^2 = 0 \\
\Leftrightarrow\quad & (b+\widehat{p})(cy+\tfrac{1}{2}y^2) - (p-\widehat{p})(c+y)^2 = 0 \\
\Leftrightarrow\quad & (b+\widehat{p})\left[\tfrac{1}{2}(c+y)^2 - \tfrac{1}{2}c^2\right] - (p-\widehat{p})(c+y)^2 = 0 \\
\Leftrightarrow\quad & (b+\widehat{p})\left[\tfrac{1}{2} - \tfrac{1}{2}\left(\frac{c}{c+y}\right)^2\right] - (p-\widehat{p}) = 0 \\
\Leftrightarrow\quad & (b+\widehat{p})\left[\tfrac{1}{2} - \tfrac{1}{2}\left(\frac{c}{c+y}\right)^2\right] - [(b+p)-(b+\widehat{p})] = 0 \\
\Leftrightarrow\quad & (b+\widehat{p})\left[\tfrac{3}{2} - \tfrac{1}{2}\left(\frac{c}{c+y}\right)^2\right] - (b+p) = 0.
\end{aligned}$$

If we define

$$\alpha \equiv \left(\frac{c}{c+y}\right)^2 \in [0,1),$$

the final expression can be rewritten as

$$\left(\frac{b+\widehat{p}}{b+p}\right)^2 = \left(\frac{2}{3-\alpha}\right)^2, \tag{16}$$

while the slope inequality (13) becomes

$$\left(\frac{b+\widehat{p}}{b+p}\right)^2 < \tfrac{1}{2}(1+\alpha). \tag{17}$$

But (16) implies (17), since it is straightforward to check that for all $\alpha \in [0,1)$

$$\left(\frac{2}{3-\alpha}\right)^2 < \tfrac{1}{2}(1+\alpha).$$

In other words, at values of $\beta \in (\beta^c, 1]$, the slope inequality $\partial\mathcal{W}^i/\partial\beta > \partial\mathcal{W}^n/\partial\beta$ holds not just when $\mathcal{W}^i = \mathcal{W}^n$, but always. This again establishes Result (ii), and thereby the Proposition.

Proof of the Corollary.

For $\beta \leq \beta^c$, we showed above that $\widehat{p} = 0$ and $x^n = x^{ih}$, implying that both optimism and consumption are independent of β. It follows that in the extreme case where parameters are such that $\beta^c \geq 1$, all agents will place zero subjective probability $\widehat{p}$ on future health consequences under ignorance, and all agents will consume the same amount.

If, however, $\beta^c < 1$, then we have for $\beta > \beta^c$ that $\widehat{p}$ is interior and does depend on β. Specifically, applying the Implicit Function Theorem to first-order condition (4) and using our result (8) above that $\partial\mathcal{W}^n/\partial\beta = -\frac{1}{2}pf(x^n)$ at $\widehat{p} > 0$ yields that

$$\widehat{p}\,'(\beta) \overset{\text{sign}}{=} \frac{\partial^2\mathcal{W}^n}{\partial\widehat{p}\partial\beta} = \frac{\partial}{\partial\widehat{p}}\left[\frac{\partial\mathcal{W}^n}{\partial\beta}\right] = \frac{\partial}{\partial\widehat{p}}\left[-\tfrac{1}{2}pf(x^n)\right] = -\tfrac{1}{2}pf'(x^n)\frac{dx^n}{d\widehat{p}} > 0.$$

Moreover, substituting $\widehat{p}(\beta)$ into (1) to obtain

$$e'(x^n) - \widehat{p}(\beta)\beta f'(x^n) = 0$$

yields that

$$\frac{dx^n}{d\beta} = \frac{\left[\widehat{p}'(\beta)\beta + \widehat{p}(\beta)\right]f'(x^n)}{e''(x^n) - \widehat{p}(\beta)\beta f''(x^n)} \overset{\text{sign}}{=} \widehat{p}\,'(\beta)\beta + \widehat{p}(\beta) > 0.$$

It follows that agents with $\beta < \beta^*$, who self-select into ignorance if given the opportunity, will on average have lower $\widehat{p}$ and higher consumption x^n than agents with $\beta > \beta^*$ who are forced to be uninformed.