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Responsible innovation in layer poultry farming: Are organic consumers sufficiently informed about the current situation of killing day-old male chicks to contribute to the innovation process?

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Abstract

Currently, there is no societal consensus on the handling of male chicks in layer poultry farming. When searching for responsible innovation in the face of ethical concerns due to the killing of these day-old male chicks, consumers as main stakeholders should be involved in the innovation process. However, participation in the innovation process requires sufficient knowledge of the current situation and its alternatives, since only this knowledge allows informed judgments. In order to gain insight into consumers' knowledge and their attitudes towards the alternative of rearing the male chicks, we conducted 146 tablet-aided standardised personal interviews with customers of a German organic butcher's shop, as these customers may be a target group for cockerel products. The results reveal the respondents' profound disapproval about the current situation of killing day-old male chicks, but also show a considerable lack of knowledge. We conclude that comprehensive educational work is necessary to enable consumers to form a sound opinion and to participate in the innovation process.

Keywords: layer poultry farming; male chicks; responsible innovation; knowledge; attitudes

1 Introduction

At present, ethical acceptance and social desirability of animal farming are strongly discussed in society. For several years, a hot spot in this public debate is the issue of killing the day-old male chicks in layer poultry farming. Even if 'the world's first ever no-kill eggs are now on sale in Berlin' and chicks' sex can be determined before they hatch (The Guardian 2018), the problem has not yet been satisfactorily solved. Of course, this patented 'SELEGGT'-method has the potential of ending culling of billions of male chicks at their first day after hatching. The method is based on the evaluation of endocrinological parameters in the allantoic fluid of the egg (SELEGGT GmbH 2018). However, the sex of a chick can be determined with this method only nine days after an egg has been fertilised. At this time, the embryo has already the shape of a chick (Hamburger and Hamilton 1951) and neuronal activity has started (Bjørnstad et al. 2015). Nobody knows exactly the onset of pain perception of a chicken embryo. Probably the embryo may feel pain before the ninth day after fertilisation (Bjørnstad et al. 2015; Wissenschaftliche Dienste des Deutschen Bundestages 2017). This uncertainty regarding the onset of pain perception in chick embryos raises doubts that consumers with high ethical claims will fully

accept the 'SELEGGT-method'. Especially organic consumers could be sceptical towards this method since these consumers usually expect a high level of animal welfare in organic production systems (Hughner et al. 2007). Another disadvantage of using the hormone concentration of allantoic fluid for sexing the chicks is the predictive accuracy of this method. The prediction accuracy of the method is higher than 98 percent under laboratory conditions (Krautwald-Junghanns et al. 2018) - but not 100 percent. According to the SELEGGT GmbH, the analysis accuracy of this method is slightly lower under practical conditions (SELEGGT GmbH 2018). Hence, some male chicks will hatch also with this method. Based on the current situation, these chicks would amount to 1 million if the error rate estimated at 2 percent. The handling of these male chicks has not yet been made transparent.

The 'SELEGGT' method is not the only option to killing of day-old chicks. Other methods of sex determination that allow an earlier diagnosis, like fluorescence spectroscopy, magnetic resonance tomography, or genetic marking of sex chromosomes, are under development (Bruijnis et al. 2015; Galli et al. 2017; Krautwald-Junghanns et al. 2018; DGS 2018).

Another approach to avoid culling chicks is rearing the males. There are two ways: fattening the 'brothers' of laying hens or the use of dual-purpose breeds. Both options are associated with economic challenges (Diekmann et al. 2017; Schütz et al. 2019) and require a fundamental rethink in organising layer poultry farming. Notwithstanding the above, rearing the male chicks is the solution that is favoured by various non-profit organisations, as BUND and BID (Bruderhahninititative Deutschland) and by Demeter, an important German organic farming association (BUND 2018; Frühschütz 2018) . However, the question arises of whether this option meets with broad societal acceptance (Brümmer et al. 2018).

A lasting solution of the problem requires support by all relevant stakeholders. According to Owen et al. (2013), the concept of Responsible Innovation (RI) may help to receive this support by considering four dimensions in the innovation process: First, there is the need to anticipate the intended and potentially unintended future impacts of an innovation. Secondly, it is necessary to reflect on underlying purposes, motivations, and potential impacts of an innovation. This includes the reflection on existing knowledge, uncertainties, assumptions, areas of ignorance and ethical dilemmas. Thirdly, this reflection needs to be opened up to broad collective deliberation, inviting and listening to wider perspectives from the public and other stakeholders. And fourthly, it is essential to respond to societal needs through effective mechanisms of participatory and anticipatory governance (Owen et al. 2012; Owen et al. 2013).

However, the aforementioned aspects of RI have so far received only limited attention when searching for alternatives to the culling of male chicks in layer poultry farming. Our case study helps to close this gap by investigating knowledge, uncertainties and ethical dilemmas related to the topic, as reflection of these aspects is a prerequisite for broad collective deliberation. In our study, we focus on the option of rearing the males. The reason for this is that we conducted our study with customers of an organic butchery who could be a target group for meat products from male layer-type and dual-purpose chicken (hereinafter referred to as cockerel products).

2 Methods

2.1 Framework conditions

In autumn 2017, an organic butchery with two stores, both located in a big city in North-Rhine Westphalia (Germany), organised an experimental sales campaign for cockerel products. This sales campaign was already the second in that year. The meat for the products originated from male layer-type and dual-purpose chicken reared as part of a research project (for more information, see Hillemacher and Tiemann (2018). The cockerels grew up in conventional free-range conditions. Therefore, the butcher placed these products separately from the organic products in the counter and marked these products as non-organic.

A poster and a counter display informed the customers about the sales campaign, its innovativeness and its backgrounds in the store. To explore possible influences of message framing, we deployed two similar optical variants of information material with different framing of the text contents. One version highlighted hedonic aspects of the cockerel products (promotion framing), the other version emphasised the customers' ethical responsibility (prevention framing) (Figure 1). The versions were used alternately day by day. The version of the poster and of the counter display were always identical with each other. Both versions contained the term

'Bruderhahn' ('brother cockerel' that is a 'brother' of laying hens) in the text, but not the term 'dual-purpose breed'.

Figure 1. Design of the poster and the counter display that were used to inform customers in the butchery. Left side: prevention message framing [Aktion Bruderhahn! (Sales campaign Brother cockerel!)]; right side: promotion message framing [Aktion 'Der Neue Hahn'! (Sales campaign 'The new cockerel'!)]

2.2 Survey

During the time of the sales campaign, we conducted 146 tablet-aided standardised personal interviews with customers of the butchery. We interviewed the customers after they had made their purchases at the butchery. Once a survey was completed, we asked each of the following customers to respond to our survey until the next customer was willing to participate. About half of the interviews we conducted during the time of promotion framing, the other half during prevention framing of the information material.

Our survey started with questions related to the participants' consumption behaviour. Then we asked the participants if they know the terms 'Bruderhahn' and dual-purpose breed. If an interviewee knew one or both of these terms or had an idea of what the term meant, we asked for associations with the respective term. Following, we assessed the participants' knowledge on the handling of day-old male chicks in layer poultry farming.

We grasped the participants' attitudes towards the killing of male chicks by using seven-point Likert scales including the option to abstain from voting. Four of the five items confronted the participants with different trade-offs.

We also asked the participants if they had bought cockerel products during the past six month. If they had not bought such products, we asked for the reason of the non-purchase.

We ended the survey by asking for demographic data.

2.3 Data analysis

We analysed all data using IBM SPSS Statistics, Version 25. First, we checked the data for completeness. We excluded three participants due to missing data. We started with descriptive statistics to analyse knowledge on

handling male layer-type chicks and alternatives to culling these chicks. The analyses of the participants' attitudes was performed in two steps: firstly, descriptive analyses of the responses to the items and subsequently binary logistic regression analyses to determine possible influences on participants' attitudes measured by the items.

In order to handle the skewed distribution of the data and to be able to include abstentions from voting in further statistical analyses, we created binary variables from the responses to the respective items. As point 7 on the Likert-scales was by far the most chosen option in all items, we coded this full agreement to an item as 1 and all the other choices including abstentions as 0.

We conducted binary logistic regression analyses with the binary coded responses to the five items as dependent variables. We included information framing, knowledge on handling male layer-type chicks, consumption of organic foods and, as sociodemographic factors, gender, age and education as independent variables in the analyses.

3 Results and Discussion

3.1 Sample description

A total of 143 questionnaires could be included in the analyses. Table 1 shows demographic details of the participants. The data are not representative for the German population, but represent the group of organic consumers characterised by a higher proportion of women, a higher level of education and a higher income (MRI 2008).

Table 1 Sociodemographic characteristics of the respondents

		Sample (N)	Sample (%) (unless otherwise indicated)
Gender	Male	54	37.8
	Female	89	62.2
Education	Lower than high school	29	20.3
	High school	21	14.7
	University	93	65.0
Net household income	< 2.600	17	11.9
	2.600 – 3.599	17	11.9
	3.600 – 4.999	27	18.9
	≥ 5.000	28	19.6
	No information	54	37.8
Age	Mean ± SD	143	55.1 ± 13.1

3.2 Knowledge on handling male chicks

To check the participants' knowledge about the handling of male layer type chicks, we asked the following question: 'What do you think, is the killing of male day-old chicks common practice in layer poultry farming in Germany?' In total, 86.0 percent of the respondents knew that culling male day-old chicks is common in layer poultry farming. However, only about half of the respondents knew that this is a common practice in conventional *and* organic farming in Germany. More than one third thought this is only common in conventional farming. The remaining participants, who account for 14 percent, had a considerable knowledge gap related to the topic. They did not know that killing male chicks a common practice (Figure 2).

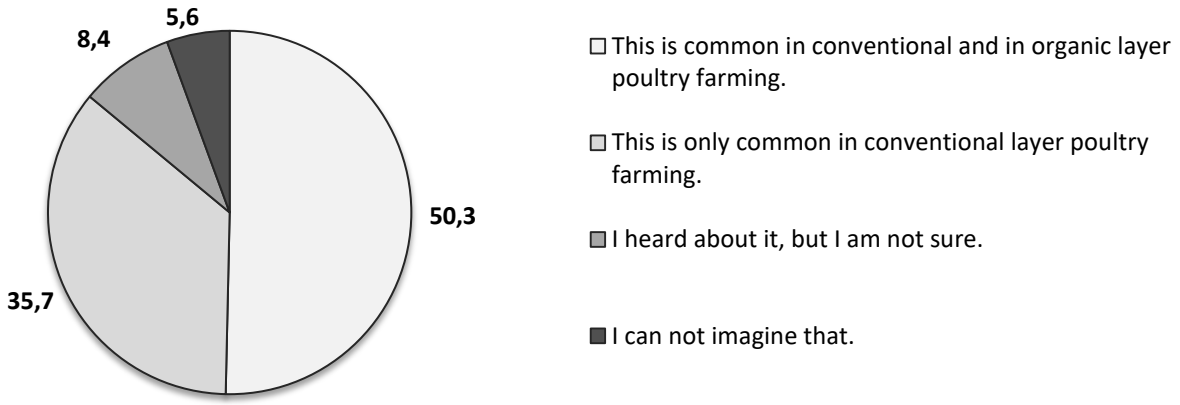

Figure 2 Knowledge related to the issue of culling day-old male chicks in layer poultry farming

When interpreting these results, it should be taken into account that our study was conducted with organic consumers, who are generally believed to be better informed than non-organic buyers, are relatively critical on nutrition issues, and more concerned about animal welfare issues (Hoffmann and Spiller 2010; Hughner et al. 2007). Moreover, during the survey time, information material on the subject of culling day-old chicks was available in the butchery, and the butcher had already organised a similar sales campaign several months ago. Against this background, it is not surprising that a larger part of the interviewees were aware about the practice of culling chicks compared to other studies [e.g. (Busse and Siebert 2017; Gremmen et al. 2018; Gangnat et al. 2018)]. However, it is somewhat unexpected that only the half of the participants answered the question correctly. This result suggests that a number of respondents were mainly critical of conventional farming, but had great trust in the organic sector. These participants probably could not imagine that the organic sector utilises ethically questionable methods, as killing of day-old chicks.

3.3 Knowledge on alternatives: dual-purpose poultry and rearing of layer type chicks for meat

We investigated the respondents' knowledge on two alternatives to the culling of male chicks by asking them for their understanding of the terms 'dual-purpose chicken' and 'Bruderhahn'. As Figure 3 illustrates, less than 10 percent of the participants were familiar with the term 'dual-purpose chicken'. This result accords with a study of Gangnat et al. (2018) who describe a low familiarity of Swiss consumers with dual-purpose poultry. Also Brümmer et al. (2018) note that German consumers have little knowledge on alternatives to the killing of chicks.

In contrast, nearly 60 percent of our interviewees stated that they are familiar with the term 'Bruderhahn'. This result could be partly due to the information provided in the butchery that mentioned the term 'Bruderhahn'. Participants who had seen the information material were significantly more frequent familiar with the term, than participants who had not seen the information (Chi-Square = 45.2, $p < .001$). The assumption, that knowledge could be explained by the participants' awareness to the information material, was confirmed by responses to a further question. We actually wanted to find out why participants did not buy cockerel products during the past six months. We primarily expected answers in the predefined categories, for example, that visiting food stores providing these products is too time-consuming or that these products are too expensive. However, the answers deviate substantially from our expectations. A total of 83 participants did not buy cockerel products during the past six months. The large majority of these participants – 73.5 percent – used the option of a free text response to cite lack of knowledge as the reason for the non-purchase. Another 14.5 percent of the participants stated that they do not know where to buy these products (predefined category). Overall, 88.0 percent of the participants who did not buy cockerel products attributed their behaviour to a lack of knowledge – this is 51.0 percent, related to the total sample.

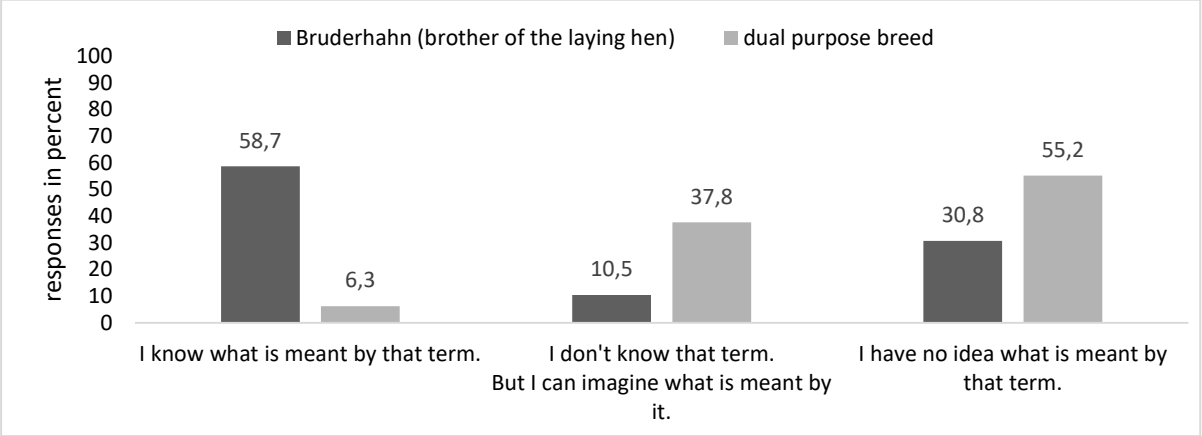

Figure 3 Responses to questions related to participants' knowledge of the terms 'dual-purpose chicken' and 'Bruderhahn' (brother cockerel)

The term 'dual purpose chicken' appears to be more self-descriptive than 'Bruderhahn'. Among the participants who did not know the respective term, only 25.4 percent had an idea about what is meant by 'Bruderhahn', but 40.6 percent could imagine what is meant by 'dual purpose chicken'.

Almost all participants who knew the term 'dual purpose chicken' or who could imagine what the term means, associated this term with aspects of use as food. 82.5 percent of these participants associated this term either with aspects of dual purpose in a narrower sense, e.g. 'meat and eggs' or in a wider sense (Hörning and Häde 2015), e.g. 'first the hens are used for laying eggs and thereafter they are used as boiling hens' or 'all chickens are used'.

In contrast, only 18.2 percent of the participants who knew or had an idea about what the term 'Bruderhahn' means, associated this term with aspects of use and marketing as food. Most of the respondents – 57.6 percent - linked this term to the common practice of killing the day-old male chicks or with the survival of these chicks. Ethical issues were mentioned by 11.1 percent. Two participants criticised the term: 'I do not like this term' and, 'Why is it a brother?'. This criticism and the relatively small share of participants who associated the term with issues of use as food could be the result of utilising anthropomorphic language. In anthropomorphic language, animals are putted on the same level as humans by using the same words for humans and animals, such as when animals are credited with having brothers and sisters, hands and fingers or thoughts and hopes (Fill 2015). The term 'Bruderhahn' is a strong anthropomorphism due to the word 'brother' and thus this term may be incompatible with the use of the cockerels for food – who wants to kill and eat a brother? Even though the term may boost the sale of eggs produced by hens whose male conspecifics have not been killed directly after hatching, the term rather seems inappropriate to initiate an objective discussion on the use of the male chicks.

3.4 Attitudes towards the killing of day-old male chicks and influencing factors on these attitudes

Point 7 on the Likert scales was the most frequently chosen answer to all items that asked for the participants' attitudes towards the chicks' lives and related trade-offs (Figure 4). This means that the participants in each item voted most frequently for the chicks' lives. The decision seemed to be easiest for the participants for the item that did not contain an apparent trade-off (only keeping poultry breeds where both sexes are reared) and for the item that mentioned the trade-off between the chicks' lives and economic disadvantages for farmers. In both cases, about 70 percent of the participants voted strongly for the chicks' lives by choosing point 7 of the Likert scales. These two items also received the least number of abstentions.

The answers to the other three items were more differentiated. When asked for their decision considering the trade-offs between rearing the chicks and environment or meaningful use of killed day-old chicks, and for a price premium for cockerels' meat without quality gain, a considerable part of respondents strongly disagreed with the statements. Between 14.0 and 19.6 percent of the participants chose point 1 of the Likert scales. All of the aforementioned items also received a higher number of abstentions from voting. The item that contained the trade-off between environment and rearing the chicks achieved the most abstentions (14.7 percent).

These findings suggest that the voting for the chicks' lives tended to be lower if the participants felt they could be affected by the consequences of their decision. A price premium without quality gain would directly affect the participants. The hedonic value of cockerel products may be high for some of the participants due to the generation of positive emotions (Franke 2013) or a 'warm-glow' effect (Bennett 2003), if they feel their behaviour may prevent chicks from culling. These persons will accept a price premium as it has more benefits than drawbacks for them personally. Other participants could see more drawbacks as they may not have the same emotional gain when preventing chicks from culling. The price premium could diminish the hedonic value of the product for these people.

Negative environmental impacts of rearing chicks could indirectly affect the participants and deciding on this trade-off may cause an ethical dilemma. The participants may feel responsible for the death of the chicks – or for negative impacts on the environment. This might be the reason for the high number of abstentions regarding this statement.

The possibility of a meaningful use of killed day-old chicks seemed to be an adequate reason for some participants to maintain the current situation. Maintaining the situation may have some advantages. In this case, people do not have to change their consumption patterns regarding chicken meat and do not have to think about the pros and cons of culling day-old chicks.

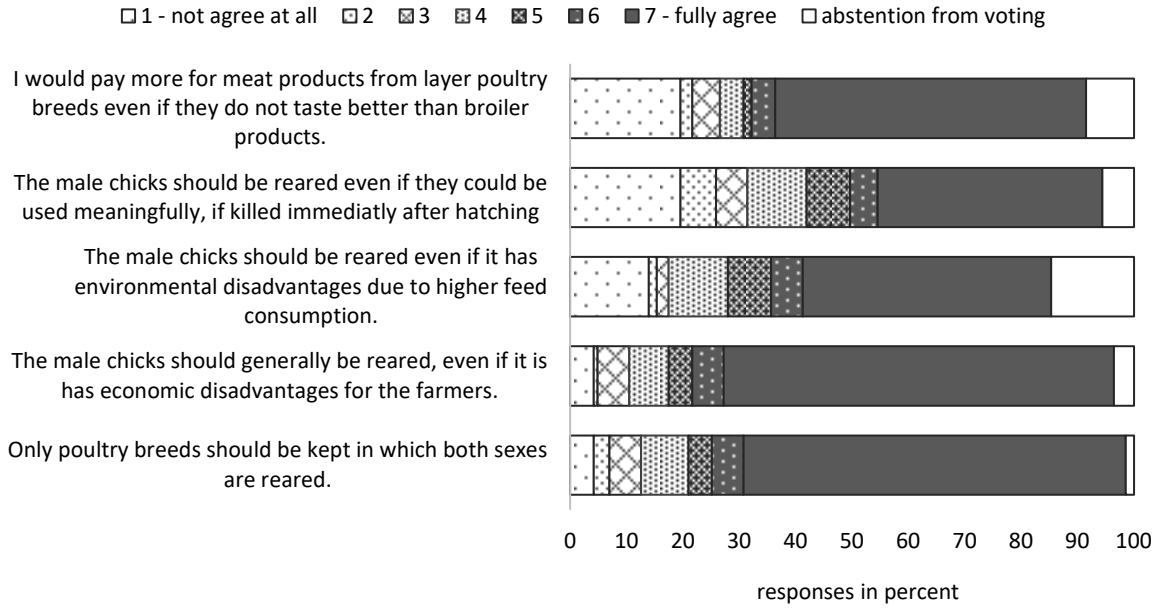

Figure 4 Attitudes towards the killing of day-old male layer-type chicks considering trade-offs measured on 7-point Likert-scales with the option of abstention from voting

Table 2 shows the correlations between the items after coding the responses as binary variables (see material and methods). The responses to the individual items only correlate significantly positive in some cases. The correlations are rather weak with $r < .50$ in all cases. This suggests that the participants' unconditional support for rearing the chicks often depended on the type of the specific trade-off they were asked for. While a participant may have fully agreed with the rearing of chicks even if it has economic drawbacks for farmers, the same participant may have disagreed if rearing the chicks has environmental disadvantages or if asked for a price premium for cockerel products.

Table 2 Correlations (Pearson's r) between the items used to determine participants' attitudes towards the handling of male layer-type chicks

Number of the item	**2**	**3**	**4**	**5**
Item 1 *I would pay more for meat products from layer poultry breeds even if they do not taste better than broiler products.*	.158	- .023	.131	.163
Item 2 *The male chicks should be reared even if they could be used meaningfully, if killed immediately after hatching.*		.054	.202*	.499**
Item 3 *The male chicks should be reared even if it has environmental disadvantages due to higher feed consumption.*			.317**	.159
Item 4 *The male chicks should generally be reared even if it is has economic disadvantages for the farmers.*				.482**
Item 5 *Only poultry breeds should be kept in which both sexes are reared.*				

Note: *significant at the .05 level; **significant at the .01 level

As it is known from the literature that sociodemographic variables, message framing or existing knowledge and behaviour can influence consumers' attitudes (Wu 2003; Aertsens et al. 2011; Hsu and Chen 2014), we examined the influence of these factors on the participants' attitudes on the issue of culling chicks. Table 3 presents the results of the logistic regression analyses. The regression model was statistically significant only for two of the five items. The independent variables partly explained the attitudes towards the exclusive use of chicken breeds where all male and female animals are reared, as well as towards a price premium for cockerel products. However, the effects of the explanatory variables were not homogenous for these two items. The likelihood of a strong agreement to the exclusive usage of dual-purpose chicken increased if consumption of organic products and age were higher. The likelihood of a strong agreement to a price premium for cockerel products increased if the participant was female, had a university degree and was younger.

Table 3 statistics and coefficient estimates of binary logistic regression model explaining participants' attitudes on the handling of male layer-type chicks

Model characteristics / **Item**	*Rearing of male chicks, even if it is associated with economic disadvantages for farmers.*			*Rearing of male chicks, even if it is detrimental to the environment due to higher feed consumption.*			*Rearing of male chicks, even if they could be used reasonably, when they are killed on their first day of life.*			*Exclusive use of breeds where all male and female chicks are reared.*			*Higher willingness to pay, even if the meat of the laying breed chickens does not taste better than the meat of conventional broilers.*		
Chi-Square	9.11			7.04			6.87			19.89			19.99		
p-value	.167			.317			.333			.003			.003		
Nagelgerke R2	.087			.064			.063			.182			.175		
mean dependent variable	.69			.44			.40			.68			.55		
Independent variables	**β**	**OR**	**AME**	**β**	**OR**	**AME**	**β**	**OR**	**AME**	**β**	**OR**	**AME**	**β**	**OR**	**AME**
information framing *binary: promotion (prevention)*	-.07 [.38]	.94	-.01	.58 [.35]	1.78	.14	-.21 [.36]	.81	-.05	.01 [.39]	1.01	.00	.32 [.37]	1.37	.07
knowledge *binary: yes (no)*	-.41 [.39]	.67	-.08	-.22 [.35]	.80	-.05	.11 [.36]	1.12	.03	-.07 [.39]	.93	-.01	.29 [.37]	1.34	.06
consumption of organic products *scale: never (1) – always (7)*	.34* [.15]	1.4	.07	.03 [.14]	1.03	.01	.18 [.14]	1.19	.04	.60*** [.16]	1.83	.11	.23 [.14]	1.25	.05
Gender *binary: Female (male)*	.16 [.39]	1.2	.03	-.29 [.36]	.75	-.07	-.25 [.37]	.78	-.06	-.10 [.41]	.91	-.02	.89* [.38]	2.44	.20
education level *binary: university (lower level)*	-.41 [.41]	.66	-.08	-.66 [.37]	.52	-.16	.22 [.38]	1.25	.05	.03 [.41]	1.03	.01	.79* [.39]	2.20	.17
Age *Scale*	.01 [.01]	1.01	.00	-.01 [.01]	.99	.00	.03* [.01]	1.03	.01	.04* [.02]	1.04	.01	-.03* [.01]	.97	-.01
absolute term	-1.29 [1.28]			.35 [1.20]			-2.92* [1.28]			- 4.16** [1.42]			-.72 [1.24]		

Note: .00 means less than .005; *significant at the .05 level; **significant at the .01 level; ***significant at the .001 level

The participants' context-sensitive choices when asked for their attitudes towards the handling of male layer-type chicks and the minor impact of demographics, existing knowledge and behaviour and message framing on these attitudes may indicate a general problem related to the topic. According to Lusk and Norwood (2011), animal welfare is a classic public good. Consequently, a chick's life has also the character of a public good, since, in our opinion, it is an integral aspect belonging to animal welfare. Peoples' attitudes towards public goods may depend on personal characteristics, such as altruism and propensity towards free-riding (Lusk et al. 2007). Unfortunately, we did not record these characteristics, and thus we were not able to integrate these variables in our logistic regression analyses. This may be one reason for the limited goodness-of-fit of the models.

On the other hand, the results may give evidence that personal moral feelings are fundamentally hurt due to the killing of young animals' lives, regardless of framework conditions and sociodemographic characteristics. The increased number of abstentions on some items may indicate that the participants were unwilling or did not feel competent to make a decision. They might prefer government regulation especially if confronted with the trade-off between two public goods - the chicks' lives and environmental impacts.

Our results also emphasise the complexity of the topic. Even if consumers are given comprehensive knowledge on the current situation of culling day-old male chicks and the pros and cons of its alternatives, it could be difficult to find a solution that is backed up by a broad social consensus in Germany. Gremmen et al. (2018) reached a similar conclusion for the Dutch public. Besides the options to vote for dual-purpose breeds and rearing layer males, the authors included additional alternatives (different strategies of in-ovo sex determination) in their survey. The data showed that there was no consensus among their participants about how to deal with male chicks in layer poultry farming. Despite the different alternatives to killing chicks, about 30 percent of their respondents would maintain the current situation (Gremmen et al. 2018). We did not ask our participants about attitudes towards options of in-ovo sex determination. We can only speculate if any of these methods would be a suitable alternative for organic consumers. It is conceivable that organic consumers will rather reject these methods due to ethical concerns and due to opposite positions of influential organic and non-profit organisations.

Even if it might be difficult to find broad public support for one solution at the present, the process of RI in layer poultry farming should go on. To follow this way, it is necessary to close stakeholders' knowledge gaps.

4 Conclusions

Our study shows the respondents' profound disapproval of the current situation, but also reveals a considerable lack of knowledge. We conclude that the implementation of the RI concept in layer poultry farming requires comprehensive educational work among consumers. New interactive and participatory communication platforms are required in RI-processes to enable stakeholders to form a sound opinion, to solve ethical dilemmas in view of trade-offs related to the handling of the male chicks, and to participate in the innovation process.

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