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The Effect of Husbandry System Information on Consumer Willingness to Pay for Dairy Products From Cow-Calf-Contact Systems

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Abstract: This study investigates consumers' willingness to pay (WTP) for dairy products from a production system with cow-calf-contact (CCC) based calf management. Our results provide insights into the extent to which consumer-driven change towards such a more animal friendly production practice is viable in Germany. We test the influence of three communication strategies on the WTP for dairy products from a CCC-based calf management production system using a hypothetical contingent valuation survey on a sample of the German internet-using population. We apply a between-subject design with random exposure to one of the communication strategies. Results indicate that consumers are willing to pay an average 20% markup for dairy products from a CCC-based production with a minimum of three months of suckling. Additional information on the benefits of cow-calf interaction for the calf increases the probability of consumers expressing a positive WTP by 8 percentage points and, given a positive WTP, increases stated markups by 16% on average. Information on other consumers' purchase behaviour or the innovativeness of the production system did not affect stated WTP in our sample. The results offer a potential upper bound for other CCC production systems, e.g., using foster cows. We conclude that information on livestock benefits in consumer communication could raise acceptance and support transitions towards more animal friendly production systems.

Keywords: WTP, Animal Welfare, Cow-Calf-Contact System, Contingent Valuation, Consumption Values, Communication Strategies

1 Introduction

Increasing societal and consumer awareness of animal welfare in the global north (Cornish, Raubenheimer, McGreevy, 2016; Clark et al., 2017) led to critical debates about common dairy production systems (Henchion et al., 2022; Schulze, Kühl, Busch, 2023). Particularly limited paddock or pasture access (e.g., Markova-Nenova, Wätzold, 2018), dehorning and, if consumers and the public are aware, early cow-calf separation (Placzek, Christoph-Schulz, Barth, 2021; Busch et al., 2017; Naspetti et al., 2021; Sirovica et al., 2022), often attributed to lower levels of animal welfare, were opposed by study respondents. However, available consumer labels for dairy products are typically tied to pasture access or organic animal husbandry and do often not address other practices (Placzek, Christoph-Schulz, Barth, 2021). This study investigates potential consumer acceptance of consumer labels for alternative calf management with prolonged suckling.

On dairy farms (conventional and organic), separating the mother cow from the calf shortly after birth is a standard practice mainly for economic efficiency reasons (Barth, 2020; Meagher et al., 2019). This practice shall ensure continuous milk yield and revenues, also due to timely insemination, and control over calf feeding, exceeding costs milk replacement, investments and workload in automated feeding or workload for bucket feeding. Alternative cow-calf-contact (CCC) based calf management enables the calf to suckle and interact with their mother or a foster cow. Demonstrated benefits of CCC include a higher body fitness and health in calves, for instance though a reduction in diarrhoea cases, and ultimately more robust cows. Economic benefits comprise lower veterinary and care costs associated and reduction of feeding and caring efforts by herd managers (Meagher et al., 2019; Waiblinger et al., 2020; Knierim et al., 2020). Enabling suckling may even become a critical aspect for ensuring consumer acceptance for dairy production systems (Buller et al., 2018; Alonso, González-Montaña, Lomillos, 2020).

Yet, CCC-based calf management may require a reorganization of the farm's facilities (Eriksson et al., 2022), and additional work for careful selection and training of mother and foster cows (Klinkmann, 2021). Farmers appear hesitant to adopt CCC calf management, mainly because of high investment and learning cost, and risky returns from more robust and healthy calves, which may even not accrue to individual farmers, and could appear hardly attributable to CCC-based calf management. A financial compensation for the risk in returns, operation and switching cost related to CCC-based calf management could incentivize dairy farms to adopt CCC calf management. Such compensation may come in form of a markup on the milk price realized through respective product labels.

Such label supported markups for specific dairy production systems, for instance with paddock and pasture access could indeed contribute to consumer acceptance (e.g., Kühl, Gauly, Spiller, 2019). Information provided to consumers about the husbandry system (e.g., organic, pasture access) and animal welfare labels, suggesting rating of animal welfare, were found as important antecedents for the willingness to pay (WTP) (Gross, Waldrop, Roosen, 2021; Stampa, Schipmann-Schwarze, Hamm, 2020). The type of information communicated appears important, for instance, additional extrinsic product quality information could affect sensory perception and hedonic ratings (Ohlau, Mörlein, Risius, 2023). However, the type of information that is the most effective for increasing consumer WTP for alternative husbandry systems such as CCC-based calf management appears under-researched.

This study aims at quantifying the effects of personal and consumption values, and information provision, on the WTP for dairy products from a CCC system in Germany using contingent valuation survey data. Based on the theory of consumption values (Sheth, Newman and Gross, 1991; van Riemsdijk et al., 2017), we develop three communication strategies (information treatments) tailored to specific consumption values: epistemic, social and emotional. By influencing the respondents' respective consumption and personal values, we hypothesize that a higher value increases respondents WTP. We apply a between-subject design with random exposure to one of the communication strategies. We test the influence of three communication strategies on the WTP for dairy products from a CCC-based calf management production system using a hypothetical contingent valuation survey on a sample of the German internet-using population. We hypothesize that information provision increases consumption value and stated WTP and that the effect varies with respondents' personal values. The hypotheses are tested by comparing the WTP to a control group that received untailored information about the dairy production system. Applying the budget approach by Nocella, Hubbard, Scarpa (2010), participants can consider the impact of repeated spending on CCC products and the implications on their monthly expenditure.

The majority of stated preference studies have relied on choice experiments to elicit WTP for animal welfare enhanced food products (Clark et al., 2017). These studies have largely focused on WTP for a single unit of the product, ignoring any quantity effects or implications of repeated consumption, despite the fact that quantity can affect stated markups (Lin, 2023).

Previous studies have also shown that personal values affect consumers attitudes and purchase intention (Shashi, Kottala, Singh, 2015), WTP (Ojea, Loureiro, 2007) for organic food and animal welfare related food choices (Cembalo et al., 2016). For instance, high personal biospheric values (concern about the natural environment) are related to various types of "green" consumer patterns such as pro-environmental purchasing intentions and experience (Caniëls et al., 2021).

The factors that influence animal welfare related food choices may also affect how sensitive consumers react to various informational clues, where less is known about the interplay of personal values and the effect of information about specific husbandry systems.

This study contributes to sustainable food systems research in three ways. First, we measure the maximum markup that consumers would be willing to pay for milk products from dairy husbandry with a CCC based calf management, i.e., this study quantifies the extent to which an unfavorable attitude towards early cow-calf separation translates into a higher WTP. Second, we analyse potential information provision effectiveness to increase consumer acceptance for CCC dairy husbandry, and third, the interplay of information, consumption and personal values of consumers. This allows us to discuss the potential for a consumer-driven change in production practices.

The remainder of the paper is structured as follows: Section 2 describes the study design, sampling, survey procedure, and materials, including the items used to measure personal values, the contingent valuation (CV) scenario with the approach for estimating WTP, the information treatments and the and measurement of consumption values. Section 3 presents the hypotheses and modelling, followed by the results in Section 4. Section 5 discusses the results and Section 6 concludes.

2 Methods

2.1 Study Design and Sampling Rationale

Participants were recruited via Bilendi, a survey recruitment provider operating in several EU countries, between July 01 and July 08, 2022, with a pre-test involving 146 respondents conducted between June 24 and June 28, 2022. Recruitment was conducted using quotas through the Mafo Institute, which used quotas reflecting the overall population in Germany based on age (18 to 69 years), gender, and education level. These quotas were determined using the latest available socio-demographic data from EUROSTAT database. Further, survey participants had to be at least partially responsible for grocery shopping in their household and have purchased milk products at least once in the last four weeks before taking the survey. Participants were incentivized by the recruitment provider based on the estimated 12-minute completion time of the survey, receiving 60 points that could be redeemed for €0.60 in cash, donated to charities, or exchanged for gift vouchers.

The study was conducted as an online survey with an experimental between-subject design. To determine the appropriate sample size, we conducted an a priori power analysis.[1] For the power analysis, we calculated the expected effect size in terms of Cohen's d (Cohen, 1988) using the following considerations: we determined the necessary effect size (WTP) to make a CCC-based livestock husbandry profitable, and calculated a sample size that would enable us to observe this effect size. We base the expected average WTP for the control group on the average weekly expenditure for dairy products of German households. This expenditure was approximately 10 euros in 2018 (Statistisches Bundesamt, 2021). We then add the additional production costs of a CCC-based livestock husbandry and the additional costs for product separation at the dairy level. We assume additional production costs for a CCC-based calf management of around €0.16/kg of milk (Klinkmann, 2021). The cost for separation of milk

[1] Calculations were done using the software G*Power (Faul et al., 2009).

products with higher animal welfare standards at the dairy level (such as markups for milk collection, processing costs, administrative costs, packaging costs, certification and label costs) are estimated at between 5.7 and 18.9 cents/kg of milk (Thiele, Thiele, 2020). Since costs for product separation are negatively related to production volume, and milk production volume with CCC-based livestock management is currently relatively low, we assume product separation costs to lie at the higher end of this cost interval. To match production cost and milk prices, we related the additional costs in euros per litre of milk to the average retailer price of €0.86/litre in August 2021 (Gierse-Westermeier, 2021). This is equivalent to a price premium of around 40% over the retailer price for conventional milk. These calculations were all related to price levels before the inflation crisis starting around the study time early summer 2022 (Zinke, 2022; Langer et al., 2023).

The necessary weekly household WTP would need to increase to 14 euros per week to cover the additional costs. Due to the high price sensitivity of consumers when buying groceries (McKinsey, 2021), a relatively high standard deviation of 8 euros is specified. A treatment effect of an increase from 10 euros to 14 euros results in a Cohen's *d* effect size of about 0.5. The goal is to power the test in such a way that not only the difference between the control group and other information groups can be detected, but also the differences between the emotional information group and the other information groups. Therefore, we choose a Cohen's *d* of 0.25. Together with a power of 0.9 and a significance level of 0.05, we obtain a target sample size of 400 respondents per group for a Wilcoxon rank-sum test.

2.2 Study Procedure and Materials

The survey was structured into three main parts. First, participants gave consent to participate in the study and provided information about their consumer dairy shopping habits and purchases. Then, personal values were elicited (see Section 2.2.1). The second part introduced the CV scenario with the respective experimental treatments, followed by comprehension checks and the elicitation of WTP (see Section 2.2.2). The final part focused on participants' consumption values and collected demographic data (see Section 2.2.3). The survey design and empirical approach were pre-registered on OSF[2] and approved by the ZEF Research Ethics Committee, University of Bonn, Germany.[3] All materials can be accessed via the GJAE Journal Data Archive (http://dx.doi.org/10.15456/gjae.2025092.2105027019).

2.2.1 Personal Values

Personal values are trans-situational goals which serve as a guiding principle in the life of a person or other social entity (Schwartz, 1994). They are important for shaping beliefs and behaviours related to the environment (Bouman, Steg, Kiers, 2018; Steg, Groot, 2012; Steg et al., 2014). Four types of values have been found to be most relevant to forecast environmental beliefs and behaviour (de Groot, Steg, 2008; Steg et al., 2014), including choices on animal welfare-friendly food products (Cembalo et al., 2016): biospheric, altruistic, hedonistic and egoistic values. People with high biospheric or altruistic personal values are concerned about the natural environment, more likely act pro-environmental and embrace environmentally friendly beliefs, even if not benefitting from it directly (Steg, Groot, 2012). In contrast, people with high egoistic or hedonistic personal values express less pro-environmental behaviours (Bouman, Steg, Kiers, 2018).

We measure these four personal values based on the Environmental Portrait Value Questionnaire (E-PVQ) by Bouman, Steg, Kiers (2018). With the E-PVQ scale respondents are not

[2] The pre-registration can be accessed here: https://osf.io/td47y/?view_only=35488c89375f46ad86a917c933d3729d. In contrast to the pre-registration, we changed the wording and refer here to a specific CCC-based form of calf management (e.g., our study excludes foster cows); we thank an anonymous reviewer for pointing this out.

[3] The code for ethical approval and the corresponding certificate is available upon request.

asked directly about their values, but are instead given a brief narrative depiction of another person, which describe a value that is important to that person (e.g., *"It is important for the person to enjoy the pleasures of life."*). The respondents are then asked to state how similar the described person is to themselves.

For this purpose, a 6-point Likert scale of the Portrait Values Questionnaire (PVQ40) in German was used, ranging from 1 (not at all like me) to 6 (very much like me) (Schwartz, 2021). We replaced one item of the original E-PVQ scale for the altruistic value, *"It is important to [them] that there is no war or conflict",* based on the concern that participants would rate this value as especially important due to the ongoing war in Ukraine and its intensive media coverage. This item was replaced by the item UN-8 from Schwartz's PVQ40 scale (Schwartz, 2021), which was slightly adjusted for this study to the following sentence: *"It is important for the person to understand and accept people with different viewpoints."*. The items for measuring the personal values are listed in **Fehler! Verweisquelle konnte nicht gefunden werden.**. In the questionnaire the order of the items was randomized.

Table 1. Items to measure personal values

Personal value	Item It is important for the person…
Biospheric value	
PV_bio1	…to prevent environmental pollution.
PV_bio2	…to protect the environment.
PV_bio3	…to respect nature.
PV_bio4	…to be in unity with nature.
Altruistic value	
PV_alt1	…that every human being has equal opportunities.
PV_alt2	…to take care of those who are worse off.
PV_alt3	…that every human being is treated justly.
PV_alt4	…to be helpful to others.
PV_alt5	…to understand and accept people with different viewpoints.
Egoistic value	
PV_ego1	…to have control over other's actions.
PV_ego2	…to have authority over others.
PV_ego3	…to be influential.
PV_ego4	…to have money and possessions.
PV_ego5	…to work hard and be ambitious.
Hedonistic value	
PV_hedo1	…to have fun.
PV_hedo2	…to enjoy life's pleasures.
PV_hedo3	…to do things (he/she) enjoys.

Source: items based on Bouman et al. (2018) and Schwartz (2021)

2.2.2 CV Scenario: Information Treatments and Budget Approach

We conducted an online CV survey to assess consumer WTP for dairy products from a CCC-based calf management. At the start of the survey, participants were randomly assigned to one of four groups: a control group and three treatment groups designed to influence epistemic, social and emotional consumption values, respectively. The control group received only factual information about the dairy production system, while the treatment groups were provided targeted information to highlight epistemic, social, or emotional values. For example, the epistemic information treatment highlighted the innovativeness of the CCC-based calf management and should be aimed to increase the epistemic consumption value. The social information treatment highlighted the large share of consumers that prefer late separation in CCC-based

livestock husbandry. The emotional treatment emphasizes the possibility for cow and calf to interact with each other. Each CV scenario consisted of three short paragraphs, with the middle paragraph tailored to the specific group (Figure 1 and Figure 2).

In conventional dairy farming, calves are raised separately from their mothers. This practice is common because in this way less disease is transmitted from cow to calf, the risk of injury to the calf is reduced, and farmers can ensure sufficient colostrum intake.

Group specific paragraph, see Figure 2.

This husbandry system requires investments for adapting stable structures, changes in management, especially more labour input, and more space for the animals. Additionally, around half of the mother cow's milk cannot be sold as long as she feeds the calf. All these changes increase production costs for farmers.

Figure 1. Contingent valuation scenario

Source: authors

Control:

Instead of separating the calves from their mothers, cow-calf-contact husbandry can be practiced. In this system, the calves stay together with their mother cows for at least three months.

Social treatment:

Instead of separating new-born calves from their mothers after the first days of their life, cow-calf-contact husbandry can be practiced. In this system, the calves stay together with their mother cows for at least three months. Surveys in Germany revealed that almost 70% of the surveyed population favors later cow-calf separation.

Emotional treatment:

Instead of separating new-born calves from their mothers after the first days of their life, cow-calf-contact husbandry can be practiced. In this system, each calf stays with its mother for at least 3 months, so that the mother cow can suckle the calf. In this way, the calf and the mother can act out their natural behaviour while the calf is able to enjoy the mother's closeness and care.

Epistemic treatment:

Instead of separating new-born calves from their mothers after the first days of their life, cow-calf-contact husbandry can be practiced. In this system, the calves stay together with their mother cows for at least three months. This husbandry requires innovative changes compared to conventional husbandry. For example, the calves need additional lying space in their mothers' boxes and additionally a separated space for retreatment that is necessary when the adult cows are led to the milking stand.

Figure 2. Contingent valuation scenario – group specific paragraphs

Source: authors

Since self-administered online surveys can result in low data quality due to inattentive participants (Meade, Craig, 2012), we included a question that checks whether participants have actually read and retrieved the main information in the CV scenario.

Participants' willingness to pay (WTP) was elicited using the budget approach proposed by Nocella, Hubbard, Scarpa (2010). Before seeing the CV scenario, respondents were asked to report their weekly household expenditure on dairy products in euros. After viewing the CV scenario, the WTP assessment was conducted in two steps. First respondents were asked whether they would be willing to pay more for dairy products from CCC-based calf management compared to conventionally produced dairy products. Those who answered "No" did not proceed to further questions about WTP. Respondents who indicated "Yes" were then asked to indicate their maximum WTP in the form of a markup using a drop-down menu with choices from 10% to 100% in increments of 10. Respondents could then see how much a given markup would increase their weekly dairy expenditures. Thus, in contrast to conventional stated preference studies that are interested in the WTP of a single unit of the product (Lin, 2023), we could investigate the influence of quantity on WTP. To reduce hypothetical bias (Cummings, Taylor, 1999), we added a cheap-talk script based on Andor, Frondel, Vance (2014).

2.2.3 Consumption Values

The theory of consumption values can be used to predict and explain consumer behaviour by identifying different motives that influence consumer choice (D'Souza, 2022). According to the theory of consumption values, consumer choice is driven by five distinct values: functional, conditional, social, emotional and epistemic consumption (Sheth, Newman, Gross, 1991). This theory has been found to have good predictive validity, and can be applied to any individual choice behaviour (Sheth, Newman, Gross, 1991). By focusing on three consumption values (emotional, social and epistemic value), we aim to identify the consumption values most relevant for consumers' decisions to buy animal welfare enhanced products (Rahnama, Rajabpour, 2017; Riemsdijk et al., 2019; D'Souza, 2022).

The consumption values refer to the perceived utility acquired from an alternative's capacity to arouse feelings or affective states (emotional value), an alternative's association with one or more specific social groups (social value) and an alternative's capacity to arouse curiosity, provide novelty, and/or satisfy a desire for knowledge (epistemic value) (Sheth, Newman, Gross, 1991). The items for the emotional consumption value and for the social consumption value are based on the scale by Sweeney and Soutar (2001). The items for the epistemic consumption value are based on the scale by Hur, Yoo, Chung (2012).

The items to measure personal values are presented in **Fehler! Verweisquelle konnte nicht gefunden werden.**. Responses were collected on a 7-point Likert scale (1 – strongly disagree to 7 – strongly agree). The order of the items was randomized. To calculate one scale for each consumption value, we summed the respective scale items and divided by the number of items.

Table 2. Items to measure consumption values

Consumption value	Item The purchase of dairy products from cow calf contact systems…
Emotional value	
CV_emo1	…is something I would enjoy.
CV_emo2	…is something I would feel relaxed about doing.
CV_emo3	…would make me feel good.
CV_emo4	…would give me pleasure.
Social value	
CV_soc1	…would help me feel accepted by others.
CV_soc2	…would improve the way I am perceived.
CV_soc3	…would make a good impression on other people.
CV_soc4	…would give me social approval.
Epistemic value	
CV_epi1	…would arouse my curiosity.
CV_epi2	…would provide me with a new experience.
CV_epi3	…would allow me to take part in an interesting development.

Source: items based on Sweeney, Soutar (2001) and Hur et al. (2012)

3 Hypotheses and Empirical Modelling

3.1 Hypotheses

We test the following hypotheses about the effects of the information treatments on consumption values and WTP. These hypotheses were established prior to data collection and documented in the pre-registration of the study.[4] The hypotheses regarding main effects are as follows:

H1: compared to the control group, exposure to the *social information treatment* increases consumers' perceived social consumption value (*H1A*) / WTP (*H1B*) for dairy products from CCC systems.

H2: compared to the control group, exposure to the *emotional information treatment* increases the emotional consumption value (*H2A*) / WTP (*H2B*) for dairy products from CCC systems.

H3: compared to the control group, exposure to the *epistemic information treatment* increases the epistemic consumption value (*H3A*) / WTP (*H3B*) for dairy products from CCC systems.

In addition, we hypothesize that the emotional information treatment has the largest effect on stated consumption value and WTP, which leads to:

H4: exposure to the *emotional information treatment* increases the emotional consumption value (*H4A)/* WTP (*H4B*) more than the other treatments.

We also hypothesize that the effect of the information varies with consumers' personal values, which leads to the following hypotheses regarding moderation effects:

[4] https://osf.io/td47y/?view_only=35488c89375f46ad86a917c933d3729d

H5: Consumers' egoistic personal value influences the effect of the social information treatment on (*H5A*) the social consumption value and (*H5B*) on stated WTP.

H6: Consumers' biospheric personal value influences the effect of the emotional information treatment on (*H6A*) the emotional consumption value and (*H6B*) on stated WTP.

H7: Consumers' altruistic personal value influences the effect of the emotional information treatment on (*H7A*) the emotional consumption value and (*H7B*) on stated WTP.

3.2 Empirical Modelling

Our empirical approach is two-fold. We start by testing the effects of the randomly allocated information treatments (emotional, social, epistemic) on (i) consumption values and (ii) the share of respondents stating a WTP greater than zero, compared to the control group, using univariate methods (one-sided t-tests and Wilcoxon rank-sum tests). Testing without multiple comparison is possible given that each treatment is tested with its own group (each respondent receives only one treatment) against the control sample.

As a second, we model the WTP decision using a two-part model (Cragg, 1971): in the first part, we model the likelihood of stating a positive WTP. In the second part the amount of WTP given that a positive WTP was stated is modelled as a function of personal values, covariates for purchasing behaviour and for socio-economics.

The two-part model is consistent with the sequential elicitation of WTP in our survey: we first asked whether respondents have a positive WTP and, given a positive WTP, we then asked for the highest acceptable price markup. That is, observations of zero WTP values, i.e., those who state that they would be willing to pay nothing more, can be interpreted as extremely pro-status quo with a small or close to zero WTP. This is in contrast to a Tobit model, where zero WTP values are unobserved (Cragg, 1971), i.e., censored values located between zero and the next lowest observed value of the WTP (e.g., Liu et al., 2019; Dow, Norton, 2003). The lowest increment in price markup in our payment ladder was 10%. It could, however, be possible that some respondents might have opted to switch to CCC products if a minimum price markup of less than 10% was offered, resulting in some censored values for the positive WTP measure. A WTP of less than 10% is much lower than the anticipated markup on retailer pricing of about 40% that would be required to offset the increase in production costs. We therefore assume that respondents with a stated WTP of less than 10% would not convert to CCC dairy products. This is consistent with the two-part model, which treats these values as zero observations (Dow, Norton, 2003).

Formally, the first part model for the probability that respondent i gives a WTP greater than zero, given the personal values and the covariates summarized in x_i, is implemented using a logit model (Winkelmann, Boes, 2006):

$$Pr(WTP_i > 0|x_i) = F(x_i\beta), \tag{1}$$

where $F(.)$ is the density function for logistic distribution of the model and β denotes the vector of coefficients to be estimated.

In the second part, we model $E(WTP_i|WTP_i > 0, x_i)$. The stated WTP is retrieved in form of markups in percentage terms of 10 discrete values ($j = 1, \dots, 10$) representing 10% to 100%. Due to the discrete nature of the data, we opt for an ordered logit model (see Eq. 2) and contrast the findings to a regression model using a respondent's household expenditure function (see Eq. 4).

The ordered logit model with respondent i's markup in category j as the dependent variable is given by:

$$Pr(markup_i \leq j|x_i) = F(\gamma_j - x_i\beta) - F(\gamma_{j-1} - x_i\beta)\,, \tag{2}$$

where γ_j denotes the threshold parameter of the distribution function to be estimated. The binary and ordered logit model (Eqs. 1 and 2, respectively) are estimated using maximum likelihood.

To model the absolute increase of expenditures, we multiply the stated households' weekly expenditures E_i for dairy products with the chosen markup. This generates a continuous variable of the maximum increase in weekly expenditure that a household is willing to accept in exchange for dairy products from CCC husbandry. This *calculated WTP* is derived as:

$$WTP_i^{calc} = (1 + markup_i) * E_i\,, \tag{3}$$

As typical for expenditure data, this variable is skewed to the right. We, therefore, use a logarithmic transformation and model $ln(WTP_i)$ as a linear function of x_i:

$$ln(WTP_i^{calc}) = x_i\beta + u_i\,, \tag{4}$$

where u_i denotes an $i.i.d.$ error term. The model is estimated by OLS.

To predict WTP in absolute terms (not log-transformed), i.e., estimates for $E(WTP_i^{calc}|WTP_i > 0, x_i)$, we retransform $ln\left(\widehat{WTP_i^{calc}}\right)$ to its original scale. We, therefore, follow Manning and Mullahy (2001) and apply the smearing estimator (Duan, 1983: 606, see Formula 3.1) to obtain unbiased quantities at the untransformed scale.[5] This retransformation requires homoscedastic errors in (4) to avoid bias (Duan, 1983: 606).

4 Results

4.1 Sample Characteristics and Scale Reliability

The total sample included 1,721 respondents. Due to quality control measures, 282 respondents were excluded: 99 for failing the manipulation check question, 109 for completing the survey in less than 50% of their treatment group's median response time (i.e., under 170 seconds), and 74 for reading the treatment text faster than 95% of all participants (i.e., under 8 seconds)[6]. Table 3 presents the descriptive statistics for the final sample (*n* = 1,439) by treatment group.

[5] For all steps we used Stata 16 using "logit", "ologit" and "reg", and the postestimation command "twopm" for obtaining the smearing estimator by Belotti et al. (2015).

[6] Another indicator for survey attendance can be response time (Revilla, Ochoa, 2015).

Table 3. Descriptive statistics of the sample

	Control (n = 363)	Emotional (n = 366)	Social (n = 353)	Epistemic (n = 357)	German population[c)]
	Mean (SD)/ Perc.	Mean (SD)/ Perc.	Mean (SD)/ Perc.	Mean (SD)/ Perc.	Mean/ Perc.
Gender	49.6%	50.5%	49.9%	50.4%	49.2%[a)]
Age	46.38 (13.66)	46.48 (13.91)	46.61 (14.03)	46.27 (14.44)	44.6[a)]
Education (A-levels)	36.9%	39.1%	36.8%	35.9%	31.3%[a)]
Net household income					
low (<2000)	38.3%	36.3%	32.0%	37.5%	33.3%[a)]
middle (2000-3500)	29.2%	33.6%	33.4%	29.7%	32.4%[a)]
high (>3500)	24.8%	21.6%	26.1%	23.8%	34.3%[a)]
missing	7.7%	8.5%	8.5%	9.0%	
Occupational status					
student or apprentice	4.7%	4.9%	4.5%	9.2%	5%[a)]
part-time	15.7%	16.9%	14.7%	16.8%	12.4%[a)]
full-time	43.5%	39.9%	47.3%	40.9%	29.3%[a)]
other	36.1%	38.3%	33.4%	33.1%	53.3%[a)]
Organic milk purchases					
< once per week	49.3%	45.1%	53.0%	46.8%	-
once per week	28.4%	33.9%	29.5%	30.5%	-
2-3 times a week	17.6%	13.9%	12.5%	16.8%	-
> three times per week	4.7%	7.1%	5.1%	5.9%	-
Dairy expenditures [b)]	22.34	25.46	22.18	23.23	-

Notes: a) sources: DESTATIS, 2023a, 2023b, 2023c, 2024b, 2024c, 2024a, 2023d;
b) weekly household expenditures in €; c) of all ages

The value scales are presented in Table 4. We used McDonald's ω (McDonald, 1999; Shaw, 2021) to measure the internal consistency of the scales. All scale values are above 0.7, suggesting that internal consistency can be considered acceptable or better (McNeish, 2018).

Table 4. Consumption and personal values scales

	McDonald's ω	Mean	SD	Min	Max
Consumption values					
Social value	0.91	3.65	1.50	1	7
Epistemic value	0.86	4.78	1.37	1	7
Emotional value	0.92	5.16	1.32	1	7
Personal values					
Egoistic value	0.79	3.25	0.98	1	6
Biospheric value	0.87	4.77	0.94	1	6
Altruistic value	0.85	4.70	0.86	1	6
Hedonistic value	0.85	4.64	0.99	1	6

Source: authors´ calculations

4.2 Effects of Information Treatments on Consumption Values and WTP

We tested the effects of the treatments on the respective consumption values and WTP using univariate testing (see Table 5). Regarding the differences in consumption values by treatment, not all treatments showed effects compatible with our sample data. The *social* information treatment increased the social consumption value from 3.62 to 3.60 (control group) (*H1A*, we

cannot reject the null hypothesis of a one-sided t-test of no differences, $p = 0.41$). Compared to the control group, the *emotional* information treatment increased the emotional consumption value from 5.11 to 5.17 (*H2A*, we cannot reject the null hypothesis of a one-sided t-test of no differences, $p = 0.27$). This also means that the emotional treatment did not increase the consumption value more than the other treatments (*H4A*). The *epistemic* treatment increased the epistemic consumption value from 4.71 to 4.91 (*H3A*, we reject the null hypothesis of a one-sided t-test of no differences, $p = 0.025$).

Regarding WTP, the *social* treatment had the smallest effect; based on statistical testing we cannot reject the null hypothesis that the treatment did not affect WTP (*H1B*). The *emotional* information treatment increased the share of respondents with a positive WTP from 70% to 78% (*H2B*). Based on statistical testing with a null hypothesis of no difference in proportions, we reject the null hypothesis ($p < 0.01$). Additionally, it increased the average markup on regular household dairy expenditures by three percentage points (based on a Wilcoxon rank-sum test, we reject the null hypothesis of no increase $p<0.01$). The *epistemic* information treatment increased the share of respondents with a positive WTP from 70% to 77% (*H3B)*; however, based on the test of difference in proportions, we cannot reject the null hypothesis at the 5% significance level ($p = 0.062$).

Table 5. Consumption values and WTP by treatment

	Control		**Social**			**Emotional**			**Epistemic**		
	Mean/ Prop.	SD	Mean/ Prop.	SD	Pr (Δ>0)	Mean/ Prop.	SD	Pr (Δ>0)	Mean/ Prop.	SD	Pr (Δ>0)
Consumption value											
Social	3.60	1.48	3.62	1.51	0.41[a)]						
Emotional	5.11	1.25				5.17	1.31	0.27[a)]			
Epistemic	4.71	1.35							4.91	1.35	0.025[a)]
WTP											
WTP > 0	0.70	0.46	0.71	0.45	0.40[b)]	0.78	0.41	0.006[b)]	0.77	0.42	0.062[b)]
Mean WTP markup | WTP > 0 [d)]	19.41	12.39	20.49	13.41	0.50[c)]	22.44	14.99	0.004[c)]	21.71	14.81	0.061[c)]

Notes: a) one-sided t-test b) test of difference in proportions c) Wilcoxon rank-sum test
d) WTP measured as % markup on regular household expenditures on dairy products
Source: authors` calculations

The emotional treatment had the largest effect on WTP, although the epistemic treatment effect on WTP was only slightly smaller and the difference was statistically not discernible (*H4B*). Figure 3 presents the choice of markup in percentage terms on the regular household dairy expenses in the control and emotional information groups. In the control group, the share of respondents with zero or 10% markup was larger than in the emotional treatment, while the share was lower for the markups between 20% and 50%. This suggests that more respondents chose the higher markups in the emotional treatment. Few respondents chose markups of higher than 50% ($n = 5$ in the control group and $n = 6$ in the treatment group).

Given the results of low or non-compatible social and epistemic information treatment effects of our sample, we conclude that replication studies should be carried out to evaluate this result further. We focus on the emotional treatment as this notably increased the WTP and evaluate these effects using the two-part model (see Equation 1-4 and Table 6). The binary logit model is presented in Table 6, column 1, the ordered logit model in column 2. We excluded the categories of above 50% because only 11 respondents in both groups selected these categories. For the linear model we used the calculated WTP (based on previous expenditures and the chosen markup) in Euros and in logarithmic terms as dependent variable is presented in Table 6, column 3.

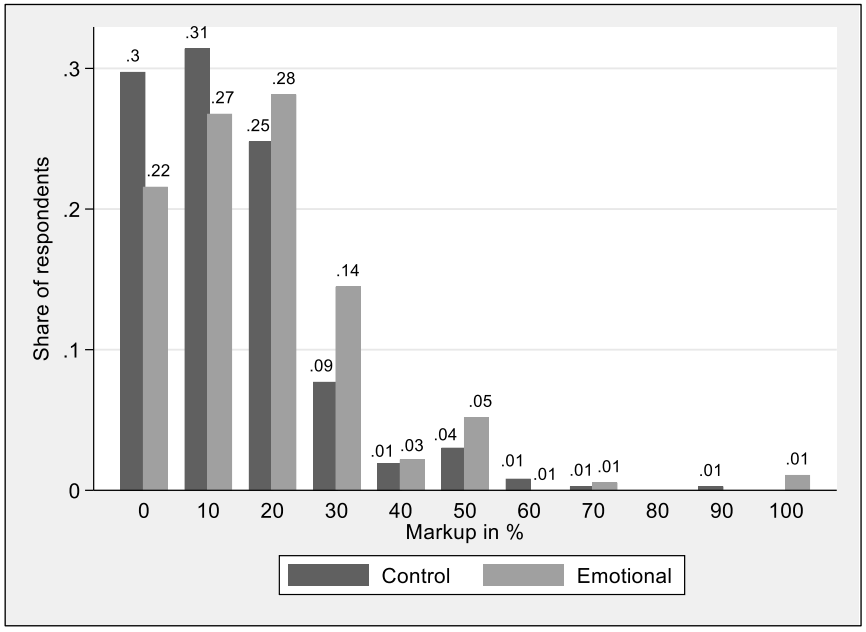

Figure 3. Share of chosen markups on the regular household expenditures

Source: authors´ calculations

The coefficient of the treatment indicator in the logit model (Table 6, column 1)[7] shows that, all else equal, the odds of stating a positive WTP are 73% higher in the emotional treatment than the odds in the control situation (*H2B*). Based on a t-test, we reject the null hypothesis of equal odds at any usual significance level. On the probability scale this is equivalent to an increase in the likelihood to state a positive WTP of 8 percentage points.

Regarding value orientation, a one unit increase on the mean-centred and standardized biospheric values scale (i.e., an increase from 4.77 to 5.77) increases the odds of stating a positive WTP by 37%, while a one unit increase on the scale of altruistic values increases the odds of stating a positive WTP by 67%. We cannot reject the null hypothesis of no interaction between treatment effect and biospheric values (*H6B*, $p < 0.79$).

For subjects who have heard of CCC-based husbandry before participating in the survey, the odds of a positive WTP are 80% higher than for subjects who have not heard of CCC-based husbandry before ($p < 0.001$). The odds of stating a positive WTP for subjects that are partly responsible for household grocery shopping are 73% higher than the odds for subjects that are mainly responsible ($p < 0.03$). We reject the null hypotheses of zero impact of these variables using t-tests. Regular consumption of organic milk also increases the odds of stating a positive WTP. Some demographic characteristics such as age, education and gender also affect the odds of stating a positive WTP.

The second column of Table 6 shows the coefficients for the ordered logit model that models the decision of the markup in percentage terms, conditional on a positive WTP (see Eq. 2). The coefficient of the treatment indicator shows that given a positive WTP, the odds to select a higher markup category for subjects in the emotional treatment were 68% higher than the odds in the control group. We reject the null hypothesis of equal odds using a t-test (*H2B*, $p < 0.01$). Regular consumption of organic milk, and demographic factors like age and income increased the odds to choose a higher markup category.

[7] The variables for the personal values are mean-centered and standardized, implying that in the presence of the interaction term of the treatment with the biospheric value scale, the coefficient of the treatment indicator is calculated for subjects with mean biospheric value.

Table 6. Results of the two-part model

	(1)			(2)			(3)		
	First part Logit model $Pr(WTP_i > 0 \mid x_i)$			**Second part ordered Logit model** $Pr(markup_i \leq j \mid x_i)$			**Second part regression** $ln(WTP_i^{calc}) = x_i\beta + u_i$		
		p	95 % CI		p	95 % CI		p	95 % CI
Emotional treatment	1.73	0.01	[1.16; 2.56]	1.68	0.00	[1.20; 2.35]	0.15	0.00	[0.07; 0.23]
Personal values [a)]									
Biospheric	1.37	0.02	[1.05; 1.79]	1.14	0.41	[0.84; 1.53]	0.07	0.06	[0.00; 0.14]
Altruistic	1.67	0.00	[1.27; 2.20]	1.18	0.22	[0.91; 1.53]	0.03	0.37	[-0.03; 0.09]
Egoistic	0.92	0.45	[0.74; 1.14]	1.09	0.34	[0.91; 1.31]	0.02	0.41	[-0.03; 0.06]
Hedonistic	1.03	0.81	[0.83; 1.27]	0.95	0.59	[0.78; 1.15]	-0.02	0.53	[-0.06; 0.03]
Treatment X biospheric	1.05	0.79	[0.73; 1.52]	0.88	0.48	[0.61; 1.27]	-0.05	0.26	[-0.14; 0.04]
Heard of CCC before	1.80	0.00	[1.20; 2.69]	1.26	0.18	[0.90; 1.77]	0.04	0.39	[-0.05; 0.12]
Partly responsible for shopping	1.73	0.03	[1.05; 2.86]	1.01	0.96	[0.67; 1.52]	0.04	0.39	[-0.06; 0.14]
Organic milk buyer									
Once per week	1.71	0.02	[1.09; 2.68]	1.48	0.05	[1.00; 2.20]	0.08	0.11	[-0.02; 0.17]
> twice per week	3.91	0.00	[2.08; 7.34]	1.81	0.01	[1.15; 2.85]	0.14	0.01	[0.03; 0.25]
Dairy expenditures (ln)[b)]	1.07	0.58	[0.83; 1.39]	0.97	0.81	[0.77; 1.22]	0.99	0.00	[0.93; 1.05]
Gender (1 = male)	0.65	0.05	[0.42; 1.00]	0.81	0.25	[0.55; 1.17]	-0.09	0.05	[-0.18; 0.00]
Age	0.99	0.17	[0.97; 1.01]	0.98	0.05	[0.97; 1.00]	0.00	0.11	[-0.01; 0.00]
Education (A-levels)	0.91	0.67	[0.57; 1.44]	1.23	0.30	[0.83; 1.81]	0.10	0.05	[0.00; 0.19]
Income									
Middle (2000-3500)	1.39	0.21	[0.83; 2.32]	1.97	0.00	[1.25; 3.10]	0.18	0.00	[0.07; 0.29]
high (> 3500)	1.62	0.12	[0.88; 3.01]	2.14	0.01	[1.25; 3.66]	0.20	0.00	[0.07; 0.33]
Household size	0.89	0.33	[0.72; 1.12]	0.89	0.27	[0.73; 1.09]	-0.06	0.02	[-0.11; -0.01]
Observations	709			523			499		
(McFadden's) R-squared	0.16			0.04			0.77		

Notes: logit coefficients displayed as odds ratios, where additional control variables are not displayed: occupational status, [a)] mean centered and standardized [b)] natural logarithm of regular household expenditures on dairy products.
Source: authors´ calculations

Referring to the *calculated* WTP linear model in column 3, the coefficient of the treatment indicator shows that, *conditional on a positive WTP*, respondents in the emotional group had a 16.5% higher WTP[8] than those in the control group. Again, we reject the null hypothesis of no effect using a t-test (*H2B*, $p < 0.001$). An increase in previous expenditures on dairy product by one percent increased stated WTP for CCC dairy products by one percent ($p < 0.001$)[9]. Regular consumption of organic milk (>twice a week) increased WTP by around 14%. Biospheric values are the only measured values that positively affect *calculated* WTP. Higher income increased WTP and household size decreased WTP.

We apply the smearing estimator to retransform $ln\left(\widehat{WTP_i^{calc}}\right)$ to its original scale, where minimal bias of this retransformation relies on homoscedasticity in error terms in the second part regression. The Breusch-Pagan and White tests indicate that we cannot reject the null hypothesis of homoskedasticity at conventional significance levels. Based on the retransformation, we find that the emotional treatment increased average weekly household expenditures from €3.76 to €4.18 (see Table 7).

Table 7. Observed and predicted WTP

	Control sample				Emotional treatment sample			
	Mean	SD	Min	Max	Mean	SD	Min	Max
WTP_i^{calc} (observed)	3.79	4.13	0.20	25.0	4.18	4.76	0.30	35.0
WTP_i^{calc} (predicted from model)	3.76	3.48	0.33	25.1	4.18	3.96	0.28	28.1

Notes: observed and predicted WTP_i^{calc} in €
Source: authors´ calculations

4.3 Interaction Effects and Moderating Role of Personal Values

The first part logit and the linear model suggest that biospheric values influenced WTP: the linear model suggests a 7% change in WTP for an increase in one unit of the biospheric value scale (because of the interaction term, for respondents in the control treatment). The interaction term's confidence intervals include zero, suggesting that the effect of treatment on $E(WTP_i|WTP_i > 0, x_i)$ does not vary with biospheric value orientation (at the mean of biospheric value). Our study may be insufficiently powered to identify small interaction effects on the WTP based on the expenditure function (*H6B*).

To make the differences in calculated WTP across personal value orientation more tangible, we present the retransformed dependent variable and plot the predicted differences in WTP conditional on biospheric value orientation in Figure 4. The negative slope indicates a tendency for larger WTP differences between treatments at low biospheric value orientations. For respondents with low biospheric values, the WTP difference between information treatments is almost €1.00 (€3.00 vs €3.98 or biospheric value of 2) while for high biospheric values the difference is only €0.23 (€4.02 vs €4.25 for biospheric value of 6). In the range of biospheric values between two and five, the confidence intervals show that the differences are strictly positive. The declining differences suggest that the effect of the emotional information treatment on stated WTP declines with increased biospheric value orientation (*H6B*).

[8] The coefficient estimate for the emotional treatment in the second-part OLS regression gives a percentage increase of: $e^{0.1527453} - 1 = 0.165$.

[9] The standardized coefficient for dairy expenditures in the second-part OLS regression gives a percentage increase of: $1.01^{.9905875} = 1.0099054$.

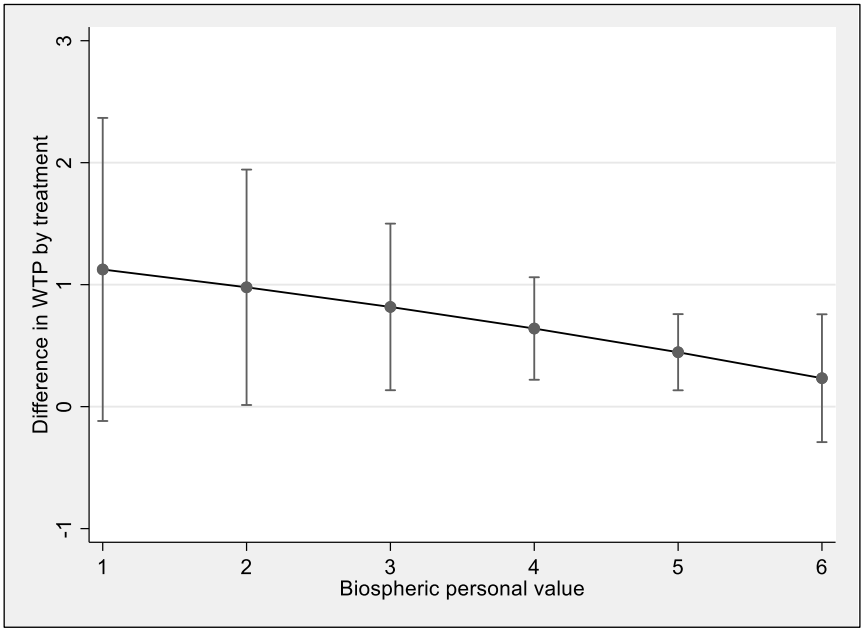

Figure 4. Difference in WTP by treatment across biospheric value orientation

Source: authors´ calculations

5 Discussion

This study was motivated by the potential of a consumer-driven change for more animal friendly dairy systems with CCC-based livestock husbandry. The main objectives were to quantify the impact of information provision on consumption values and WTP for dairy products from a CCC system in Germany, and to examine how consumers' personal values influence the effects of the information provision. We designed three information treatments tailored to the consumption values that have been identified as most relevant for consumers' decisions to buy animal welfare products. We measured WTP in a contingent valuation scenario that took the budgetary effect of regular consumption of these products into account. To retrieve the effects of information provision, we implement a between-subjects design with a control group that was offered only factual information on duration of suckling.

Based on univariate testing, we find, if at all, only small differences in the social, emotional, and epistemic consumption values, which are compatible with our sample. The emotional treatment shows effects for our sample: providing information on the duration of prolonged suckling coupled with its positive effects on calf behaviour can increase stated WTP. The factual information on duration of suckling (control group) led 70% of respondents to state a positive WTP and, on average, pay a 20% markup over the retailer price for conventionally produced milk. With the additional information on calves' behaviour, the share of respondents with a positive WTP increased to 78%. Based on the two-part model, we find a markup of about 16.5% over the markup of the control group. This effect does not vary with biospheric values (important to prevent environmental pollution, protect the environment, respect nature etc. see Table 2), where high biospheric values could indeed be shown to increase WTP. The effect of the information provision on stated WTP-markups was higher for respondents with low personal values than for respondents with high personal values (yet not compatible for the expenditure based linear model, where expenditure enters in logged terms). This result suggests that reliance of sales of CCC products on customers' high biospheric personal values might be compensated by providing information on the benefits from cow-calf interaction for calves. For German consumers, the most intensively investigated dairy product attribute is pasture access. Based on their choice experiment, Markova-Nenova, Wätzold (2018) found a WTP of €0.24/litre for a combination of free stall and pasture access, which is equivalent to a 30%-40% markup over

the price for conventional milk at that time. Kühl, Gassler, Spiller (2017) found a WTP of €0.38 for pasture-raised milk, equivalent to a markup of between 47% and 63% on the average milk prices at that time. These high markups relative to the markups in our study may derive from the high importance of pasture access that consumers assign to dairy husbandry systems (Kühl, Gauly, Spiller, 2019). This might point to a higher importance of pasture-access to consumers but also demonstrate low awareness of early cow-calf separation. Also, the markups elicited in these choice experiments are not directly comparable to the markups in our study. Besides using a CV and not a choice experiment, we applied the budget approach (Nocella, Hubbard, Scarpa, 2010), which made the effect of regular consumption of these products on weekly household spending and thus the individual budget constraint evident to the respondents. If households had a positive WTP, previous expenditures on dairy products reduced the stated markup that households were willing to pay. Such a quantity effect has also been demonstrated by Lin (2023). This quantity effect is rarely included in WTP estimations based on choice experiments in which respondents state WTP for a one-time consumer decision. This may also partly explain why our markup of about 20% is lower compared to other studies.

Related to an average retail price before the inflation crisis (and thus before our study) but in alignment with available switching cost estimates for farms of €0.86/litre (Gierse-Westermeier, 2021), the increase in overall production costs along the chain would lead to an increase of 18%. This suggests that respondents may be willing to pay these increases in production costs. However, the inflation crisis has shown that consumers remain price sensitive and switch to conventionally produced products. This highlights the importance of information strategies. For instance, CCC-based calf management and pasture access may offer a promising strategy to reduce product separation costs and avoids another separate label (Kühl, Gassler, Spiller, 2017).

As any empirical study, our study comes with limitations: the scenario that we applied in the survey was referring to mother-cow contact instead of the option to also use dams as foster cows. This may reduce mental load for the respondent; however, relying on foster cows can increase dairy farmers' acceptance of CCC-based calf management (Barth, 2022). How consumers value this practice in comparison to a pure mother-cow suckling has yet to be explored. Another limitation may be that our elicitation requires respondents to estimate their weekly dairy expenditures in order to see the effects of their choice on their weekly budget. This approach proved to give reliable results in the context of pork expenditures (Uehleke, Hüttel, 2018), but may be less reliable in the case for dairy products, which can be quite heterogenous. For example, infrequent but relatively expensive purchases like quality cheese may be forgotten in the account. This would result in an underestimation of the expenditures and thus the impact on the budget constraint, but may not apply to all respondents. The hypothetical bias may also add to this overstatement of WTP. We, therefore, suggest interpreting the stated WTP as an upper bound of real WTP. The comparison of WTP across information treatments is less affected by this possible overstatement of WTP since as long as these biases affect WTP in all scenarios equally, the relative effect of the information treatment remains unaffected by these biases. For future studies, it could be interesting to investigate how mean WTP and the information effects vary by other socioeconomic factors, such as regional differences that may arise from different exposure to productions systems. Lastly, the influence of the inflation crisis with a notable increase in weekly expenditures for food and thus dairy products, along with recent trends to alternative plant-based consumption calls for a replication of the study.

6 Conclusions

Consumers were willing to pay a 20% markup on their household dairy costs to ensure that their products came from CCC husbandry systems. This result demonstrates the potential of emphasizing this production system in marketing and product labelling. Highlighting the positive impact of cow-calf interaction on the calves could attract consumers who value animal welfare. Our results showed that additional information on the benefits of cow-calf interaction for the calves increased the share of respondents that expressed a positive WTP as well as

their average accepted price markups. Our findings suggest that there may be room for price increases for dairy from CCC systems, and that providing information on the benefits for the animals, for example on product packaging, could further increase consumer acceptance. Still, the WTP markups for CCC systems in our study are lower than those reported for pasture-based production systems. Further research should investigate the reasons behind this difference, for example by examining consumer responses to informative labels across different production systems, such as pasture-based systems and CCC systems. This can help to identify areas for improvement and potentially adapt strategies that increase willingness to accept price markups for dairy products from CCC systems.

Conflict of Interest Statement

The authors declare that there are no conflicts of interest.

Data Availability Statement

The data used in our empirical analysis are available at http://dx.doi.org/10.15456/gjae.2025092.2105027019.

CRediT Author Statement

R.U.: Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Writing – original draft, review editing; J. K.-L.: Conceptualization, Methodology, Formal analysis, Investigation, Writing – original draft, review editing; S.H.: Conceptualization, Methodology, Investigation, Writing – original draft, review editing Resources, Writing – Original Draft, Supervision, Project Administration, Funding Acquisition.

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