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Farmers' preferences for automatic lameness-detection systems in dairy cattle

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ABSTRACT

As lameness is a major health problem in dairy herds, a lot of attention goes to the development of automated lameness-detection systems. Few systems have made it to the market, as most are currently still in development. To get these systems ready for practice, developers need to define which system characteristics are important for the farmers as end users. In this study, farmers' preferences for the different characteristics of proposed lameness-detection systems were investigated. In addition, the influence of sociodemographic and farm characteristics on farmers' preferences was assessed. The third aim was to find out if preferences change after the farmer receives extra information on lameness and its consequences. Therefore, a discrete choice experiment was designed with 3 alternative lameness-detection systems: a system attached to the cow, a walkover system, and a camera system. Each system was defined by 4 characteristics: the percentage missed lame cows, the percentage false alarms, the system cost, and the ability to indicate which leg is lame. The choice experiment was embedded in an online survey. After answering general questions and choosing their preferred option in 4 choice sets, extra information on lameness was provided. Consecutively, farmers were shown a second block of 4 choice sets. Results from 135 responses showed that farmers' preferences were influenced by the 4 system characteristics. The importance a farmer attaches to lameness, the interval between calving and first insemination, and the presence of an estrus-detection system contributed significantly to the value a farmer attaches to lameness-detection systems. Farmers who already use an estrus detection system were more willing to use automatic detection systems instead of visual lameness detection. Similarly, farmers who achieve shorter intervals between calving and first insemination and farmers who find lameness highly important had a higher tendency to choose for automatic lameness detection. A sensor attached to the cow was preferred, followed by a walkover system and a camera system. In general, visual lameness detection was preferred over automatic detection systems, but this preference changed after informing farmers about the consequences of lameness. To conclude, the system cost and performance were important features, but dairy farmers should be sensitized on the consequences of lameness and its effect on farm profitability.
Key words: farmer preference, technology adoption, discrete choice, automated lameness detection

INTRODUCTION

Adequate health and welfare monitoring are becoming an important challenge in modern dairy farming (Algers et al., 2009; de Boyer des Roches et al., 2014). Therefore, new sensor technologies to monitor animal health are being developed (Rutten et al., 2013). As lameness is one of the most important health problems, automatic lameness-detection systems are being developed to improve cow health, lowering financial losses and improving animal welfare (Bruijnis et al., 2010; Solano et al., 2015; Van Nuffel et al., 2015b).

The adoption of automatic lameness-detection systems may depend on various factors. In particular, experiences of early adopters, farmer's perception of the lameness problem, and the estimated return on investment may influence the adoption in practice. First, reports of early adopters on their experiences will affect the purchasing behavior of other farmers. Positive experiences may induce a bandwagon effect (Baerenklau, 2005), encouraging other farmers to invest as well. How-

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ever, if the early adopters are dissatisfied, their reports can make other farmers reluctant to purchase such systems, leading to poor adoption caused by a reverse bandwagon effect. Farmer involvement in research and development may help to avoid this by designing systems that meet farmers' expectations (Sanders, 2002; van der Weerdt and de Boer, 2016). Thus far, farmers seem to not yet be involved in the development process of automatic lameness-detection systems.

Second, farmers' perceptions about lameness and its effect on farm profitability may impede the adoption of new technology. Although farmers indicate having enough knowledge (Leach et al., 2010), they are often not aware of the true lameness prevalence in their herd. Wells et al. (1993), Whay et al. (2002), and Espejo et al. (2006) concluded that the prevalence estimated by farmers was 2.5, 4, and 3.1 times lower than the estimation by experts, respectively. The consequences of lameness are also underestimated, implying that farmers are typically not aware of the effect of lameness on farm profitability (Leach et al., 2010). Lack of awareness about lameness, its causes, possible ways to prevent or treat it, and the effectiveness of actions taken, is likely to limit the intentions of farmers to reduce lameness on their farm (Leach et al., 2010; Bruijnis et al., 2013). For example, Alawneh et al. (2012) stated that the interval between detection of the lameness case and treatment was more than 3 wk for more than 40% of the severely lame cows, indicating that treatment is often delayed. Bruijnis et al. (2013) found that 25% of the respondents in their study did not believe that cows could suffer pain, although animal welfare was valued as important. These perceptions could falsely lead to the conclusion that new technology is not useful, and hence impede an investment. Main et al. (2012) showed that monitoring and supporting farmers can encourage them to change their lameness management. Thus, farmers might change their attitude about automatic detection systems when they are well informed.

Third, farmers' willingness to adopt new technology also depends on the economic effects of the investment on farm profitability. Borchers and Bewley (2015) concluded that the return on investment, the total investment, and the system performance are important features when considering technology adoption. Therefore, manufacturers should find out how much a farmer wants to pay for a detection system with certain features to design systems that are both affordable and profitable for the farmer.

The goals of our study were, therefore, to (1) investigate which system characteristics of automatic lameness-detection systems are important to farmers, (2) find out how sociodemographic and farm characteristics influence farmers' preferences for lameness detection technology, and (3) find out how farmers' preferences change after receiving extra information about lameness.

MATERIALS AND METHODS

Experimental Design

General Approach. A discrete choice experiment was used to investigate which lameness-detection system characteristics determine farmers' preferences. Discrete choice experiments are part of a method to elucidate stated preferences frequently used in agriculture to examine consumer choice behavior in hypothetical situations (Hensher et al., 2005; Lips and Gazzarin, 2008; Louviere et al., 2010). Stated preference approaches can be used for new developments not yet introduced to the market (Meenakshi et al., 2012), which is the case for automatic lameness-detection systems. A disadvantage, however, is that the results are potentially biased, as potential end users could make choices without considering personal constraints (Hensher et al., 2005; Lagerkvist et al., 2006). Therefore, the hypothetical scenarios used in the experiment have to be as realistic as possible (Hensher et al., 2005).

The following potentially important characteristics were put forward: percentage missed lame cows, percentage false alarms, costs per cow per year, and indication of the lame leg. After giving the farmer extra information on the prevalence and cost of lameness, the same experiment was repeated immediately to explore the effect of this extra information on stated preferences.

Respondents were asked to choose between 3 alternative lameness detection systems: a sensor attached to the cow, a walkover system, and a camera system. A fourth option (opt out) was provided to allow respondents to choose human visual inspection as the preferred system to detect lame cows (Table 1). Each option represented a different type of lameness detection with different levels (values) for the system characteristics. An example of such a choice set is illustrated in Table 1.

The system characteristics were chosen based on our experience, conversations with farmers and discussions during seminars for farmers. The associated levels (value of the characteristic) were based on values reported in recent literature and actual prices of devices, such as accelerometers, already used in practice for estrus detection (Table 2; Bicalho et al., 2007; Van Hertem et al., 2014; Van Nuffel et al., 2015a).

The choice sets were designed using Ngene (ChoiceMetrics, Sydney, Australia) to obtain the smallest possible orthogonal design, to keep the minimum number of respondents needed for the analysis as low as pos-