Who do UK consumers trust for information about nanotechnology?

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ABSTRACT

This paper investigates UK consumers' trust in sixteen information sources, from government institutions to food handlers and media, to provide accurate information about the use of nanotechnology in food production and packaging. We elicit the perceived trust using a well-known choice-based stated preference technique, namely best-worst scaling. The results from the analysis of a scale-adjusted latent class model show considerable heterogeneity in consumers' perceptions of trust and choice variability. The findings from this study provide insights into the development of best practices and policies in risk communication and management for novel foods produced by nanotechnologies. More specifically, they highlight how targeted approaches can be used by policymakers responsible for disseminating information relating to novel technologies.

1. Introduction

Nanotechnology, which can be described as the creation and manipulation of materials at the nano (one-billionth) scale, is one of the emerging technologies that has attracted considerable attention within the food industry. This attention has stemmed from the technology's potential for developing innovative products and applications for food processing, preserving and packaging (FAO/WHO, 2013; Prasad et al., 2017; Chaudhry et al., 2017). Nanotechnology can, for example, be used for 'smart' packaging that has the capability to monitor the condition of foods during storage and transportation. As a result, it has the potential to extend shelf-life, enhance tastes and quality, reduce the need for preservatives, salt and fat, and improve the nutritional value of food (García et al., 2010; Chaudhry and Castle, 2011; Chaudhry et al., 2017). Not surprisingly, the food industries in a number of countries, including the USA, Australia, New Zealand, South Korea, Taiwan, China and Israel are exploring its use. However, for the most part, these developments are still at the research and market development, or near-market stage (Chaudhry and Castle, 2011; Food Standards Agency, 2016).

Although nanotechnology has a number of promising applications, its use in the food industry remains limited. This slow uptake is mainly due to a lack of information and uncertainties linked with its potential health and environmental impacts (Stampfli et al., 2010; Food Standards Agency, 2010; Anderson et al., 2012). This has significantly increased consumer concerns, especially over its effectiveness, long-term side effects, and ability to ensure safety (Lyndhurst, 2009; Gupta et al., 2017), as well as how their impacts will be handled, and by whom (Gavelin et al., 2007; Food Standards Agency, 2010). There are also doubts in consumers' minds, which has, consequently, led to mistrust in the organisations and people involved in food production (Roosen et al., 2009; Nocella et al., 2014). This makes risk communication and management more difficult for policy-makers and other stakeholders (Ding et al., 2013). Therefore, it is important to understand the reactions of consumers towards nanotechnology and the levels of trust they have in institutions who provide information on the technology before it is more widely used in the food industry. Knowing public views of, and the preferences for, new technology will also help design communication strategies, such as awareness campaigns and other public policy messages targeting different consumer segments. This is particularly relevant given the contentious history of previous technologies, such as genetic modification (Bennett and Radford, 2017). Indeed, some of the controversies relating to genetically modified foods include the effect of consuming such foods might have on health and the environment, the role of government regulators, the objectivity of scientific research, and whether or not such food should be labelled. These have affected consumers' purchasing behaviour, as found in a review by Costa-Font et al. (2008).

There are many factors influencing how consumers might respond to the use of new nanotechnologies. These include, *inter alia*, media coverage, personal experiences with earlier novel technologies, general underlying attitudes, beliefs, knowledge and preferences. Among these factors, the level of trust a person has in the food system (producers, processors, retailers) and in the regulatory process watching over it, is

likely to be important. In the case of the introduction of new technologies, trust is considered to be one of the key constructs (Anderson et al., 2012; Roosen et al., 2015; Gupta et al., 2017). In particular, when consumer knowledge and experience of a new technology are limited, consumers may rely heavily on the advice provided by experts. This serves as a mechanism to reduce the complexity of judging the risks and benefits of the new technology (Siegrist and Cvetkovich, 2000; Gupta et al., 2017). On the other hand, the lack of trust in institutions could impact adoption of new technologies and generate political resistance to policies (Hobbs and Goddard, 2015).

This paper investigates UK consumers' perceived levels of trust in information sources regarding the use of nanotechnology in food production and packaging using the best-worst scaling (BWS) technique. Specifically, this paper explores how trust perceptions vary with consumers' characteristics and the extent to which consumers make consistent choices in relation to the institutions that they believe are trustworthy (i.e., choice variability). Analysing heterogeneity in trust perceptions combined with the consistency of choices has been largely overlooked in trust studies.

The research also contributes to the literature by providing new empirical evidence on consumers' perceived trust in information sources about the technology. Moreover, to date, studies investigating institutional trust have focussed on a relatively small number of sources of information. For example, Lang and Hallman (2005) investigate trust in ten institutions; Coveney et al. (2012) focus on five institutions; Roosen et al. (2009) and Bieberstein et al. (2010) study trust in three institutions; Anderson et al. (2012) look into governmental agencies and scientists only; and Macoubrie (2006) focus on only government and regulatory agencies. By extending the analysis to sixteen sources of information including a wide range of institutions and individuals in the food chain, the research provides unique insights into trust in a much broader context. In terms of the policy implications, the research provides insights into how best to develop communication strategies targeting certain consumer segments with the aim of improving their food safety and risk behaviour.

2. Trust in information sources

Trust has been defined in various ways in the literature. While there is no consensus on its definition, it is generally considered as a multifaceted concept and analysed with the dimensions or factors that influence it. For example, from a socio-psychological perspective, Lewis and Weigert (1985) and Bradbury et al. (1999) analysed trust within three dimensions (or attributes): cognitive, affective, and behavioural. The cognitive dimension "involves a choice based on a reasoning about the available evidence and is based on a degree of cognitive familiarity with the object of trust" (Bradbury et al., 1999, p. 118). The affective dimension of the trust involves an emotional bond between the truster and trustee, implying the existence of a perception that the trustee shares important values with the truster (Lewis and Weigert, 1985). Damage to this kin, therefore, weakens the relationship. The behavioural dimension involves actions taken under the belief that others also take similar actions. Cvetkovich (1999) calls this latter dimension "shared values" or "trustworthy behaviour". Although these dimensions are analytically separate, they are combined in actual human experience (Bradbury et al., 1999). For example, someone's behavioural display of trust may build up cognitive and affective trust in another. Other dimensions most commonly identified in the literature centre on competence, objectivity, fairness, consistency, empathy, honesty, and openness (Renn and Levine, 1991). Trustworthiness is influenced by how these dimensions are perceived by individuals. For example, willingness to disclose information (i.e., openness) and fairness can be interpreted as a means of demonstrating concern and care for others and, as a result, could influence the perceived trustworthiness (Peters et al., 1997).

In addition to the mentioned dimensions, trust is commonly

classified into broader categories. These include trust in regulatory systems (sometimes termed as institutional trust), trust in other people (generalised trust), trust developed over time due to interactions and experience (relational trust), and trust based on a rational evaluation of benefits and costs of (in)actions of trustee (calculative trust) (Roosen et al., 2015; Ding et al., 2015).[1] Depending on the conceptual treatments of trust, various approaches can be used for the analysis. For example, Poppe and Kjærnes (2003) and Chryssochoidis et al. (2009) analysed trust with the factors influencing it, such as perceived institutional characteristics, information characteristics, risk characteristics, individuals' socio-cultural characteristics, and the existence of similar values or prior attitudes regarding risks. In contrast, others analysed trust with its role in risk perceptions (e.g., Siegrist and Cvetkovich, 2000; Viklund, 2003) and technology acceptance (e.g., Lang and Hallman, 2005; Anderson et al., 2012).

Studies investigating trust in information sources show variation in the context and information sources included in their analysis. The context has varied from technological risks, such as genetic modification (Hunt and Frewer, 2001; Anderson et al., 2012), irradiation (Frewer et al., 1996), and nanotechnology (Siegrist et al., 2008; Bieberstein et al., 2010), to environmental issues (Maeda and Miyahara, 2003; Brewer and Ley, 2013). The number of institutions included in these studies has varied from government institutions to friends and family. While a number of studies focussed on trust in government authorities only (e.g., Poortinga and Pidgeon, 2003; Coveney et al., 2012), some included various other information sources. For example, Maeda and Miyahara (2003) investigated trust in industry, government, and citizens' groups, Siegrist and Cvetkovich (2000) and Coveney et al. (2012) focussed on media, government, friends, food industry and scientists, and Priest et al. (2003) included ten institutions varying from media to environmental groups and farmers.

As nanotechnology is an emergent technology, there are only limited studies on consumers' trust in information sources (for example, Lee and Scheufele, 2006; Siegrist et al., 2008; Bieberstein et al., 2010; Capon et al., 2015; Roosen et al., 2015). The types and number of institutions included in these studies, as well as the country focus are varied. For example, Bieberstein et al. (2010) investigated trust in the food industry, science and research, and governmental organisations in Germany. Capon et al. (2015) studied trust in health department, scientists, journalists, and politicians in Australia. Anderson et al. (2012) investigated trust in scientists and government agencies in the USA, and Macoubrie (2006) focussed on trust in the US Government only.

3. Methodology

The means by which the trust in different information sources is elicited and analysed in this paper differs from past trust analyses. Trust studies typically involve asking respondents multiple statements, such as 'to what extent the following source can be trusted[..]?', on a Likert-type scale (e.g., strongly agree to strongly disagree). The responses to these statements are then analysed using descriptive statistical methods (e.g., finding mean scores or frequencies) (e.g., Viklund, 2003; Nocella et al., 2010) or factor analytic and principal components approaches (e.g., Bieberstein et al., 2010; Hartmann et al., 2015). The descriptive methods used in the trust studies generally involve calculating the mean of 'trust' rating scores respondents assign to each institution. Whereas, the factor analytic or principal component analysis approaches examine the pattern of correlations (or covariances) between the observed measures (e.g., rating responses to various statements) to explain the underlying constructs influencing the responses. In this

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[1] An overview of different conceptual treatments of trust can be found in Hobbs and Goddard (2015), which is published in a special issue focussing on consumers and trust in this Journal.