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## Acceptance of nuclear power: The Fukushima effect



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### HIGHLIGHTS

- ▶ Longitudinal studies are important for risk perception research.
- ▶ The accident in Fukushima had only a moderate impact on acceptance.
- ▶ Acceptance of nuclear power before and after Fukushima was highly correlated.
- ▶ People have stable attitudes towards nuclear power.

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### ABSTRACT

Utilizing a longitudinal study design, the impact of the 2011 accident in Fukushima on acceptance of nuclear power and the evaluation of several scenarios with different percentages of nuclear power were examined. Mail surveys were conducted in the German-speaking part of Switzerland. The first survey took place before the accident in Fukushima (Autumn 2010), the second survey immediately after the accident (March 2011), and the third survey half a year after the accident (October 2011). A sample of 463 persons participated in all three surveys. The accident had a negative impact on the acceptance of nuclear power. The mean change was moderate, and high correlations between the measurement points were observed. Overall, participants thus showed rather stable attitudes towards nuclear power across the three measurement waves. Results of the present study demonstrate the importance of prior beliefs and attitudes for the interpretation of an accident. The evaluation of the various scenarios was strongly influenced by participants' pre-Fukushima attitudes towards nuclear power.

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## 1. Introduction

In various countries, discussions about the future of nuclear power have been fueled by the accident in the Fukushima Daiichi nuclear power plant in Japan. This accident happened March 11, 2011. It was the result of an enormous earthquake and the subsequent tsunami, combined with a power company that was not well prepared for such an event. After the accident, radioactive elements were released or leaked from three reactors into the environment. People living in a 30 km radius around the power plant were evacuated.

Based on the research about the accident in Chernobyl, it is known that such accidents may result in a more negative attitude towards nuclear power (Eiser et al., 1989; Verplanken, 1989). The accident in Japan provided an opportunity for examining additional research questions. In a longitudinal survey that included three waves, the present study examined how the accident in

Fukushima influenced attitudes towards and acceptance of nuclear power immediately after the accident and half a year after the accident, compared to before the accident. The study design allowed investigating the stability of attitudes towards nuclear power. The study further examined how attitude towards nuclear power and the accident in Fukushima shaped the evaluation of scenarios with different percentages of national power being produced by nuclear power plants.

### 1.1. Lay people's perception of nuclear power

Public perception of nuclear power is a key factor of whether it is used in a country for the production of electricity (Goodfellow et al., 2011). Results of the psychometric paradigm, using aggregated data, suggest that nuclear power is perceived as a rather dreadful and unknown hazard (Fischhoff et al., 1978; Slovic, 1987). This finding could be replicated by analyzing non-aggregated data, in which individual differences were taken into account (Siegrist et al., 2005). The dreadfulness dimension seems to be associated with an affective evaluation of the hazard (Dohle et al., 2010). Due to these

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qualitative aspects of nuclear power, lay people tend to perceive nuclear power as a risky technology.

The affect heuristic suggests that images associated with, and associations evoked by, nuclear power determine people's perception of this technology (Slovic et al., 2004; Finucane et al., 2000). The importance of affect for shaping people's perception of nuclear power has been shown in several studies (Dohle et al., 2010; Keller et al., 2012; Siegrist et al., 2006). Opponents and proponents not only differ in the proposed affect evoked by this technology, but also in the concrete images and associations. Affective images seem to determine people's acceptance of nuclear power (Keller et al., 2012). People opposed to the replacement of nuclear power plants associated nuclear power plants with images like radioactivity, nuclear accidents, risks and negative consequences for health and the environment, or even nuclear war. These results indicated that the concepts of risk and dread are more often expressed by people who oppose the replacement of nuclear power plants than by people who are in favor of nuclear power plants. People who supported the replacement of nuclear power plants often associated nuclear power plants with neutral and positive concepts such as energy, and to a smaller extent, with necessity. The perception of beneficial energy supply primarily explains their acceptance of replacing nuclear power plants. Thus, people in favor of replacing nuclear power plants perceived nuclear power plants as a viable and safe technology that ensures future energy supply.

Affect evoked by nuclear power may also be an important determinant of perceived benefit and perceived risk (Finucane et al., 2000). Some researchers have focused only on risk perception associated with the acceptance of nuclear power, and not on benefit perception (Whitfield et al., 2009). However, it seems that possible economic benefits are the main driver for proponents of the technology. Opponents of the technology value the economic benefits of this technology much less, and are, therefore, not willing to accept the risks associated with it (Eiser and van der Pligt, 1979). In a study conducted in Switzerland, it was found that benefit perception (i.e., secure energy supply) is the most important predictor for acceptance of nuclear power plants, and that risk perception is a less important predictor (Visschers et al., 2011). Even though nuclear power does not emit CO<sub>2</sub> when producing electricity, climate change concerns have only had limited impact on acceptance of nuclear power plants (Corner et al., 2011; Visschers et al., 2011). If nuclear power was framed as a contribution to climate change mitigation, acceptance of the technology increased a bit, but even then the impact was small (Pidgeon et al., 2008).

People's acceptance of nuclear power may be influenced by the alternatives that are available. In one study, it was shown that US residents wanted greater reliance on solar, wind, and hydroelectric energy sources (Greenberg, 2009). About half of the respondents were in favor of a decrease in electricity produced by nuclear power, and the other half of the respondents were in favor of the status quo or of an increase of nuclear power production. However, it seems that people evaluate nuclear power more positively when they receive some information about the technology, and when they have to rank various energy scenarios, and, therefore, have to make some trade-offs (Fleishman et al., 2010).

### 1.2. Studies examining attitudes before and after a nuclear accident

Immediately after the accident in Chernobyl, people had more negative attitudes towards nuclear power, and they perceived more risks (Renn, 1990). The more a country or region was affected by fallout caused by the accident, the stronger was the attitudinal change (Drotz-Sjöberg and Sjöberg, 1990; Renn,

1990). Furthermore, results suggest that the accident had a short term effect (i.e., some time after the event, opposition towards nuclear power decreased again) (Renn, 1990; Verplanken, 1989). It should be noted, however, that in one study the Chernobyl accident actually decreased the perception of threat (Lindell and Perry, 1990). However, this study was conducted in the US; respondents were, therefore, distant from the place of the accident.

Most of the studies that examined the impact of a nuclear accident on people's attitudes and risk perceptions utilized cross-sectional data. There are only a few longitudinal studies that allow examining of the stability of attitudes within individuals (Eiser et al., 1989; Lindell and Perry, 1990; Midden and Verplanken, 1990; Verplanken, 1989). A longitudinal study conducted in the UK showed that, after the Chernobyl accident, people showed greater opposition to existing nuclear power plants and to new power plants in the UK compared with before the accident (Eiser et al., 1989). Regarding non-nuclear industrial developments, like new chemical plants or oil wells, no changes in attitudes could be observed. The authors focused on mean differences between the two measurement points, but they did not report correlations across the measurement points.

Midden and Verplanken (1990) compared within-subject analysis and between-subject analysis of attitudes towards nuclear power, using longitudinal data, after the Chernobyl accident. Based on the results of this comparison, the authors concluded that attitudes towards nuclear power are much less stable over time than one would expect based on across-subject analysis. Longitudinal data are, therefore, needed for a better understanding of psychological processes related to the perception of hazardous technologies.

The stability of the attitudinal measures before and after a nuclear power accident can either be investigated by analyzing the mean values or the correlations. Based on past research, it seems clear that nuclear accidents result in more negative attitudes towards the technology (Eiser et al., 1989; Verplanken, 1989). Even though accidents have changed the means of the measured constructs, there can still be high correlations between the pre- and the post-measures. Such a result would indicate that all participants, independent from their perception of nuclear power before the accident, have similarly changed their attitudes or perceptions. Only one study reports correlations between pre-Chernobyl and post-Chernobyl measures (Lindell and Perry, 1990). For 10 of the 18 variables they investigated, significant test-retest correlations were observed; all of the correlation coefficients were below 0.5. These results suggest, therefore, that attitudes to and perceptions of nuclear power measured both before and after an accident are only moderately correlated.

### 1.3. Changes in attitudes towards nuclear power since previous nuclear accidents

Since the nuclear accident in Chernobyl in 1986, the public's perception of nuclear power seems to have changed. Polls in the USA about the acceptance of nuclear power show that attitudes towards nuclear power have become more positive since the late 1980s (Bolsen and Cook, 2008). Lately, a similar increase in acceptance of nuclear power was found in Europe (European Commission, 2010). Rising oil prices and more concern about climate change have been suggested as having caused this increased support for nuclear power. These factors were part of a so-called "nuclear renaissance," i.e., a revival of nuclear power (Teräsväinö et al., 2011; World Nuclear Association, 2011). The benefits of nuclear power for the climate appeared only slightly related to the public's acceptance of this technology (Corner et al., 2011), especially compared to the relation between perceived

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