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Original Article

Can implicit cognition predict the behavior of professional energy investors? An explorative application of the Implicit Association Test (IAT)

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ABSTRACT

This article reports on the results of two studies involving seventy-seven professional investment managers in Switzerland. We designed an Implicit Association Test (IAT) to investigate whether unconscious attitudes toward renewable versus non-renewable energy sources influence investment behavior. In Study 1, we find that there is indeed a correlation between implicit associations and our dependent variable, net investment in solar energy. In Study 2, we replicate the results from Study 1 and also show that implicit associations are more strongly correlated to investment behavior than explicit associations, suggesting that application of the IAT may add value to the analysis of energy investor behavior. As an example of investigating factors influencing decision-making "in the wild", our study is subject to a number of limitations that can be used as starting points for further research in this area of high societal relevance.

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1. Introduction

"Investing in solar energy is fraught with policy risk", "In the solar market, we simply don't see the returns we are looking for", "Generating solar energy in Germany makes as much sense as growing pineapples in Alaska". When assessing the risk-return profile of investing in solar energy compared to their core business of non-renewable energies, many energy industry professionals until recently expressed an intuition that suggests they do not associate this newly emerging technology with what they would consider a good investment. A particular case in point are the two oil industry managers who made the first two statements above to one of the co-authors in 2009, when talking about their company's decision to divest from a solar technology company, only to enthusiastically go on and talk about their latest investment in a Siberian oil field – which they implicitly seemed to associate with lower levels of policy risk.

As these examples show, there may be more to the assessment of energy investment opportunities – especially in the high uncertainty environment of investing in new innovative technologies – than the sophisticated analytical processes usually described in corporate finance textbooks. In fact, more subtle, conscious or unconscious associations of certain investment targets like solar energy or fossil fuels to attributes like "risk" and "return", or more generally "positive" and "negative", seem to be also present in decision-makers' minds. Investigating such associations and uncovering their influence on actual investor behavior could strengthen existing models of decision-making, potentially contributing to solving prevalent empirical puzzles, such as why despite mounting evidence of global climate change (IPCC, 2014), investors appear to be locked in to existing investment patterns (Unruh, 2000).

An obvious challenge, however, is that by their very nature, implicit associations are hard to measure. Common methodological approaches in management research, such as relying on expert interviews or document analysis, will therefore fall short of providing an accurate account of the unconscious elements that may be powerful elements of decision-making (Greenwald & Banaji, 1995; Nisbett & Wilson, 1977; Uhlmann et al., 2012). Recent advances in psychology have offered new insights and methodological tools, allowing to open the black box and get a "window to the mind" of decision-makers. A particular example is the Implicit Association

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Test (IAT) developed by Greenwald, McGhee, and Schwartz (1998) and applied in a wide range of decision areas (for an overview, see Bargh, 2007; Fazio & Olson, 2003; Greenwald, Poehlman, Uhlmann, & Banaji, 2009; Hofmann, Gschwendner, Nosek, & Schmitt, 2005; Uhlmann et al., 2012). Most of the IAT applications so far have been conducted with student or consumer samples, leaving the question unanswered whether implicit associations also play a role in the context of experienced professional decision-makers, and if so, how this links to the choices they make. This paper describes, to the best of our knowledge, the first application of the IAT to a sample of professional investment managers in the energy domain. In two studies with a total of seventy-seven energy investors, we measure their implicit associations toward solar energy and gas, and explore their influence on investment behavior.

The context of our research is a high-uncertainty investment context, the Swiss energy transition. After the Fukushima nuclear accident in 2011, the Swiss government decided to phase out nuclear power, currently accounting for 40% of the country's electricity generation, while sticking to its greenhouse gas emission reduction targets (www.energiestrategie2050.ch). As a consequence of this political decision and the cost reductions that occurred in solar energy worldwide, many observers see investment in solar energy as a huge market opportunity (Aanesen, Heck, & Pinner, 2012; Bazilian et al., 2013; Della Croce, Kaminker, & Stewart, 2011). However, accurately predicting future cash flows from investing in solar or other energy technologies is a challenging task, given dynamic technology development, volatility in the price of fossil fuels, and a changing policy landscape. In this context, professional energy investors, including both electric utilities and financial investors such as banks and pension funds, have been slow to pick up on the solar opportunity in Switzerland (Windisch, Friedrich, Wanner, & Wüstenhagen, 2011). In contrast, homeowners and other non-professional energy investors were much faster to react, to the extent that – similar to what has been observed in other countries (Helms, Salm, & Wüstenhagen, 2015) – 80% of all new photovoltaic power generation capacity is now owned by private investors or commercial roof owners (Chassot, 2012). Interestingly, many Swiss homeowners report to rely on their intuition rather than sophisticated forms of financial analysis when making such building-related energy investments (Ebers & Wüstenhagen, 2015).

While this paper does not attempt to take sides in the raging debate whether – or rather: under which environmental conditions – intuitive or analytic processes lead to better decisions (Samuels, Stich, & Bishop, 2002; Gigerenzer, 2007; Kahneman, 2011), our objective is to explore professional investors' implicit associations to renewable versus non-renewable energy sources, and to understand whether those are reflected in their investment behavior. Additionally, as is common practice in many IAT studies (Greenwald et al., 2009) and in order to ensure validity of our findings, we distinguish implicit from explicit associations, and test if the impact of implicit cognition on decision-making prevails if we control for explicit associations to renewable versus non-renewable energy sources.

Our research questions, therefore, are:

(1) What is the impact of implicit cognition on decision-making of professional energy investors?
(2) In a high uncertainty context, is implicit cognition more closely linked to actual behavior than explicit cognition?

The rest of the paper proceeds as follows. Sections 2 and 3 present the two empirical studies (including methods, results and discussion), Section 4 contains a general discussion of our findings, and concludes the paper with practical implications, limitations and suggestions for further research.

2. Study 1

2.1. Method[1]

2.1.1. Implicit Association Test (IAT)

An IAT tests how strongly the participant implicitly associates a concept (e.g. an energy source such as *solar energy*) with an attribute (e.g. *good* or *bad*, *return* or *risk*). The association strength is measured in relative comparison with association of a second concept (e.g. *gas*) to the same attribute, which makes this method particularly applicable to decision contexts where choices are often made between contrasting categories (e.g. the decision to invest in either solar energy or gas). The test operates by presenting pairs of target categories and attributes in two opposing constellations, to find out whether one is more compatible with implicit associations in the respondent's mind than the other, and then asking respondents to assign stimulus words appearing in the middle of the screen to either target categories or attributes on the left or right side of a screen, and measuring reaction times for this task. As Nosek, Banaji, and Greenwald (2002) explain, the crucial assumption of the IAT is that it ought to be easier to pair concepts that belong together in a participant's mind. For example, most respondents would spontaneously rather associate the concept *flower* with the attribute *pleasant* than the concept *flower* with the attribute *unpleasant.* "The extent to which it is easier to pair *flower* + *pleasant* (in the presence of a contrasting pair, e.g., *insect* with *unpleasant*) compared with the opposite pairings (e.g. *flower* + *unpleasant* and *insect* + *pleasant*), the stronger is the assumed positive implicit evaluation of flowers relative to insects." (Nosek et al., 2002, p. 45 f.) In this example, ease or strength of association is measured by the speed to respond under a compatible constellation (e.g., *flower* + *pleasant*) compared with an incompatible constellation (e.g., *flower* + *unpleasant*).

We applied the IAT to measure implicit cognition on renewable vs. fossil energy. Instead of *flower* and *insect*, our target categories were *Photovoltaics* and *Gas* in Study 1. Instead of the attributes *pleasant* and *unpleasant*, we used *Risk* and *Return*. This led to the two test constellations illustrated in Fig. 1, where in one case *Photovoltaics* was paired with *Return* on the left and *Gas* with *Risk* on the right side of the screen (task 1), while in the other case *Gas* was paired with *Return* and *Photovoltaics* with *Risk* (task 2). In both tasks illustrated in Fig. 1, stimulus words like for example *Renewable Energies* appeared in the middle of the screen. As the participant learned in the first part of the test and could also recognize by the font color, this stimulus belongs to the target category *Photovoltaics*. Therefore, in the first task, where *Photovoltaics* was on the left hand side of the screen grouped with *Return*, participants had to assign the stimulus to the left hand side by pressing the "e"-key on the keyboard. In the second task, the target word *Photovoltaics* appears on the right hand side of the screen together with *Risk*. The correct answer here was to assign the stimulus word *Renewable Energies* to the right by pressing the "i"-key. A participant with a stronger association of *Photovoltaics* to *Return* should be faster in task 1 than in task 2, because for him, the combination of target categories and attributes in task 1 represents the compatible constellation, whereas the opposite combination in task 2 represents the incompatible constellation, which requires additional processing time. The IAT measures differences in reaction times between the tasks (in milliseconds), and calculates for each respondent a *d*-score, which indicates relative speed of reaction under the two contrasting constellations – and is hence a measure

[1] The easiest way to understand how an IAT works is to participate in one; demo tests are available online on the homepage of Project Implicit, which was founded by Greenwald, Banaji and Nosek, who developed the IAT. https://implicit.harvard.edu/implicit/takeatest.html

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