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Emotions in long-term financial decision-making: Relevance and measurement

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SURVEY PAPER 51

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Abstract

Typical characteristics of a long-term financial decisions such as related to retirement planning are that the consequences of decisions taken today only materialize in the distant future, and that the decision environment is complex. We argue that, in this setting, reliance on emotional decision heuristics is highly important. The goal of this article is to enhance the knowledge of emotions within the context of long-term financial decision making. Knowing more about emotions in long-term financial decision-making will ultimately help, for example, to get pension plan participants more engaged in retirement planning.

We first define emotions, distinguish them from feelings and moods, explain the difference between basic and non-basic emotions, and present different classifications of emotions. Since the measurement of emotions is anything but simple, we review and compare the different ways to measure emotions, from studying the brain, observing facial expressions, and studying written texts, to using self-report survey measures. We provide examples of different studies that research the role of emotions in the pension context, and we briefly summarize the key insights from three ongoing research projects on emotions in relation to retirement planning. Writing about retirement results in emotional texts, we find that different emotions are evoked, depending on whether retirement planning is perceived as more aleatory (random) rather than epistemic (knowable) and that, for older age groups, positive emotions are more intense and negative emotions less intense. Furthermore, our results reveal that emotions, especially anxiety, play an important role in retirement planning and have an effect on participants' behavior. This has implications for policy makers, pension providers, and financial advisors as they should take participants' emotions into account when communicating about pensions so that negative sentiments are reduced.

Samenvatting

Emoties en langetermijnbeslissingen op financieel gebied: Relevantie en meting

Langetermijnbeslissingen op financieel gebied, zoals binnen de pensioencontext, worden gekenmerkt door hun complexiteit en het feit dat de gevolgen ervan slechts in de verre toekomst te merken zijn. We beargumenteren dat bij het maken van dit soort beslissingen, het gebruik van "emotional decision heuristics" van groot belang is. Het doel van dit artikel is om kennis over emoties in het algemeen, en in het bijzonder wanneer het gaat om financiële beslissingen voor de lange termijn, te vergroten. Meer kennis over emoties op het gebied van langetermijnbeslissingen op financieel gebied zal uiteindelijk helpen om, bijvoorbeeld, pensioendeelnemers meer betrokken te krijgen bij hun pensioenplanning.

We definiëren emoties, maken onderscheid tussen emoties en de termen gevoelens en gemoedstoestand, geven het verschil aan tussen basale en niet-basale emoties en presenteren verschillende manieren om emoties te classificeren. Emoties kunnen worden gemeten en dat gebeurt op verschillende manieren. Verschillende technieken om emoties te meten worden vergeleken. Dit varieert van het meten van hersenactiviteit, het observeren van gezichtsuitdrukking en het bestuderen van tekst tot "self-report survey"-methodes. We geven voorbeelden van verschillende studies die kijken naar de rol van emoties binnen de pensioencontext en vatten de belangrijkste bevindingen van drie lopende onderzoeksprojecten samen over emoties en pensioenplanning. Daaruit blijkt dat het schrijven over pensioen tot emotiegeladen teksten leidt, dat de ontstane emoties afhangen van of pensioenplanning wordt gezien als willekeurig of meer met kennis te maken heeft. Ook zien we dat voor ouderen, positieve emoties intenser zijn en negatieve emoties minder intens vergeleken met jongeren. Bovendien tonen de resultaten aan dat emoties en vooral de emotie angst een belangrijke rol spelen bij pensioenplanning en een effect hebben op het gedrag van deelnemers. Dit heeft implicaties voor beleidsmakers, pensioenaanbieders en financieel adviseurs, want door rekening te houden met emoties in hun wijze van communiceren naar deelnemers kan negatief sentiment afnemen.

Policy Implications

As pension systems place more risk and responsibility on individual persons, it is crucial for pension plan participants to engage more in retirement planning. There is a large body of literature on the role of cognitive factors, such as financial literacy, numeracy and economic preferences, as predictors of retirement planning. There is also a large knowledge base on the role of emotions in decision-making. For example, research has shown that irritation and fear can discourage behavior (Lee & Andrade, 2011; Lerner & Keltner, 2001). Yet, evidence on the role of emotions in retirement planning is limited, even though the long-term and complex nature of retirement planning suggests that they are of particular importance in this context. Early work in this area confirms that retirement anxiety (Eberhardt, Brüggen, Post & Hoet, 2016) and negative emotions (Bronner, 2016) play an important role in the pension context.

In this paper, we present the key insights from three ongoing research projects on emotions and retirement planning. Initial analysis suggests that writing about retirement results in more emotional texts than what is commonly found in personal writing. Also, we find that emotions related to retirement depend on the type of uncertainty that people experience. Respondents who perceive retirement planning as more aleatory (random) than epistemic (knowable) are more afraid and irritable, but also excited. Higher perceived levels of epistemicity are positively related to happiness. In a third study, we find that retirement anxiety is strongly and positively related to behavioral intentions to engage in different facets of retirement planning. Also, older respondents reveal more positive emotions and less negative emotions compared to younger respondents.

These findings have implications for policy makers, pension providers, and financial advisors. First, these insights can be used in pension communication. We argue that it is important to account for the emotions of participants and to frame the emotional tone in pension communication so that desirable behavior is triggered. How exactly information should be framed depends on the exact goal of the communication, but emotions can be stimulated or instead attenuated through the specific choice of words in the main message, but also through headings or email subject lines. We also recommend that pension communication is pre-tested not just in terms of how understandable the information is, but also to see which emotions are evoked. Second, our research identifies heterogeneity between respondents: emotions depend on the age of participants, as well as on how they construe the uncertainty around retirement planning. This indicates that it is important for policy

makers, pension providers, and financial advisors to target their communication to specific groups of people. And third, since the challenge of engaging participants in their retirement planning is great, we believe that the sector needs to combine its efforts and to collaborate in enhancing the knowledge base on what drives or hinders retirement planning. It is important that this originates from a common understanding of the key concepts, that the research is conducted competently, and that the findings are shared with the sector. By presenting this overview of emotions and their definition and conceptualization and by explaining the different ways in which emotions can be measured, we hope to contribute in providing policy makers, pension providers, and financial advisors with the necessary knowledge.

1. Introduction

Even though the Dutch pension system does not allow participants much choice in terms of the selection of a pension fund or investment strategy, it is still important that people inform themselves about whether they are on track to meet their retirement income goals. As Knoef et al. (2016) point out, one third of the Dutch population is at risk of facing a retirement gap. For this group it is important to understand the risk they face and to take additional measures. Yet, even for the other two thirds of the population it would be beneficial to acquire information on their accrued pension rights since that would them realize that there are on track with respect to their retirement planning so that do not need to worry, which they nonetheless often do. For many pension plan participants their retirement is still far away, so thinking intensely about their pension situation and taking action is not high on their agenda (Brüggen, Rohde, & Van den Broeke, 2013). It is thus highly important to unravel why participants are not much concerned about their pension and what they can do about it.

Studies to this date that try to understand the behavior of participants focus primarily on cognitive factors such as financial literacy, numeracy, and economic preferences as predictors of pension planning. Relatively little attention has been given to the role of emotions in retirement-related behavior. As Loewenstein (2000) and Loewenstein and O'Donoghue (2004) point out, emotions are often another important driver of economic decisions and should therefore not be left out of economic analyses and models. Psychological research reveals that in situations where a person's motivation to process information is low, and where such person is distracted or cognitively constrained or lacks expertise, reliance on emotional decision heuristics increases (de Bruin, Parker, & Fischhoff, 2007; Ottati & Isbell, 1996; Peters & de Bruin, 2012; Petty, Schumann, Richman, & Strathman, 1993; Pham, Cohen, Pracejus, & Hughes, 2001). Since those characteristics apply to the pension context, it is likely that emotional decision heuristics play an important role. Early empirical studies on this topic confirm that retirement anxiety (Eberhardt et al. 2016) and negative emotions (Bronner, 2016) play a role in the pension context. Also anecdotal evidence highlights positive as well as negative emotions in this context. For example, some pension advertisements focus on conveying a positive and emotional tone. A good illustration of this is the campaign used in the past by the Dutch insurance company Zwitserleven, which centered around creating a 'Zwitserleven gevoel', a relaxed and worry-free retirement period. In contrast, media coverage on pension-related topics, such as the rising retirement age (England, 2016), the increase of contribution levels, the lack of

indexation, or the uncertainties in the retirement system, generally conveys negative emotions about the contributions and, even more so, in the reader's reaction to such news items. Anger and fear are emotions that are often displayed, as illustrated by the following quotes: "A total disgrace! People in the 45-55 age group are already planning their retirement and a further postponing of the state retirement age will steal yet more money off them. People must protest and stop this madness" (England, 2016)[1] or "Thinking about our old age scares us" (de Koning, 2015).

Given the potential relevance of emotions, this paper aims to enhance the knowledge of emotions and the understanding of the role of emotions in decisions in the pension context. Knowing more about emotions in retirement decision-making will ultimately help to get pension plan participants more engaged in retirement planning.

This paper is structured as follows. In Section 2, we define emotions, distinguish emotions from feelings and moods, explain the difference between basic and non-basic emotions, and present different classifications of emotions (the wheel of emotions, cognitive structure of emotions, discrete emotion theory, and the emotional circumplex). In Section 3, we review and compare the different ways of measuring emotions (brain and nervous system, observable expressive patterns, and the experience of consciously feeling an emotion). In section 4, we provide examples of different studies that research the role of emotions in the pension context, and we briefly summarize the key insights from three ongoing research projects on emotions and retirement planning. We end with a summary and conclusion.

1 This is a comment on http://www.independent.co.uk/news/uk/politics/pension-age-set-to-increase-again-former-minister-claims-steve-webb-70-a7443211.html

2. Emotions

Charles Darwin already touched upon emotions in his book "The Expression of the Emotions in Man and Animals" (Darwin, 1872). Darwin explains that facial movements express emotions and that this behavior developed gradually throughout evolution since it is not only present in humans, but also in more developed animals, such as apes. He emphasized the evolutionary heritage of emotions so that in consequence they are hard-wired into our behavior. Ever since Darwin there have been many scholars who studied the subject of emotions. Those scholars do not, however, agree on the origin and function of emotions, which has led to complementary but also often conflicting views on emotions, their properties, and processes. To date, there is still no agreement on the definition of emotion. Disagreement on the definition of emotion has been argued to make progress in the field difficult (Aman & Szpakowicz, 2007; Kleinginna Jr. & Kleinginna, 1981; Ortony & Turner, 1990; Richins, 1997). The two most established definitions of emotion in psychology and human decision-making science were coined by Izard (1992) and Plutchik (1962). Izard (1992, p. 561) defines emotions as "specific neuropsychological phenomena, shaped by natural selection, that organize and motivate physiological, cognitive, and action patterns that facilitate adaptive responses to the vast array of demands and opportunities in the environment." According to Plutchik (1962, p. 151), "an emotion may be defined as a patterned bodily reaction of either destruction, reproduction, incorporation, orientation, protection, reintegration, rejection or exploration, or some combination of these, which is brought about by a stimulus." Both definitions have an evolutionary and bio-psychological perspective.

We have chosen to provide a definition which is not based on the interpretation of one researcher, but which is the result of reviewing many definitions and hence most complete. Kleinginna Jr. and Kleinginna (1981) reviewed over one hundred definitions and created a definition that includes most viewpoints. Their definition includes the various ways in which an emotion can manifest itself as well as how emotions are triggered. According to them, an "emotion is a complex set of interactions among subjective and objective factors, mediated by neural-hormonal systems, which can (a) give rise to affective experiences such as feelings of arousal, pleasure/displeasure; (b) generate cognitive processes such as emotionally relevant perceptual effects, appraisals, labeling processes; (c) activate widespread physiological adjustments to the arousing conditions; and (d) lead to behavior that is often, but not always, expressive, goal-directed, and adaptive" (Kleinginna Jr. & Kleinginna, 1981, p. 355).

In everyday language, the term "emotion" is often used interchangeably with feelings or mood. Still, these are conceptually different, although related concepts. Feelings are still rather similar to emotions but are generally less intense (Aaker, Stayman, & Vezina, 1988, p. 2). Moods are conceptually different from emotions in that they do not result from a specific event. Moods do not necessarily have a definable onset and end, which emotions usually do have (Gardner, 1985). Moods can last longer than emotions, even for hours, days, or weeks. A person might furthermore not be aware of his or her moods and their effect, whereas emotions tend to be tied to certain behaviors and to be more intense, plus a person is likely to be aware of his or her emotions and their effects (Forgas, 1995; Gardner, 1985; Phelps, Lempert, & Sokol-Hessner, 2014). If someone is in a bad mood, then this does not necessarily lead to an emotion, but a certain mood can lead to a higher probability of the appearance of certain emotions. In short, feelings are conceptually similar but less intense than emotions, and moods are more general in the sense that they do not result from a specific event. Affect is a term that includes all three concepts.

Some authors classify certain emotions as basic. Many theorists give basic emotions a special status as they are believed to be hardwired in our DNA for coping and adaptation because of evolutionary development (Darwin, 1872; Izard, 1992, 1993). Basic emotions have their own facial expressions (Izard, 1977) and are related to actions or instincts such as the instinct of flight when someone is afraid (Plutchik, 1962). Such emotions seem to be basic, because they can also be found in higher animals. Table 1 lists the basic emotions used by different authors.

Table 1 makes clear that the set of basic emotions is not universally accepted, even though most authors include happiness, sadness, fear, and anger. Another observation is that, while some emotions are given different names, it seems as if many are the same. For example, panic is labeled distress by one author and terror by another

Table 1: Basic Emotions

Author	*Basic emotions elicit*
Plutchik, 1958, 1980	fear, anger, joy, sadness, acceptance, disgust, surprise, expectancy (=anticipation, 1980)
Tomkins,1962	*surprise*, *interest*, joy, *rage*, *fear*, *disgust*, *shame*, anguish
Izard, 1977	interest, enjoyment, surprise, distress (sadness), anger, disgust, contempt, fear, shame/shyness, and guilt
Alm, Roth & Sproat, 2005	anger, disgust, fear, happiness, sadness, positive surprise and negative surprise
Aman & Szpakowicz, 2007	happiness, sadness, anger, disgust, surprise and fear, plus mixed emotion and no emotion
Quan & Ren, 2010	expectation, joy, love, surprise, anxiety, sorrow, anger and hatred

(Ortony & Turner, 1990). Correspondingly, Diener, Smith, & Fujita (1995, p. 131) confirm this phenomenon, as they point out that some emotions are described in more varying ways than other emotions, with some words expressing the same emotion but with different levels of intensity.

Non-basic emotions are often assumed to derive from a mix of these basic emotions (Diener et al., 1995, p. 131)). In general, terms and concepts that distinguish basic from non-basic emotions are complexity, sophistication, and self-consciousness. Izard (1977) explains non-basic emotions as a compound of two or more basic emotions, where the new emotion contains the properties of its bases. An example of Izard's explanation is guilt, which is composed of fear and shame, because a person who experiences guilt feels shameful and fearful at the same time.

Classification of Emotions

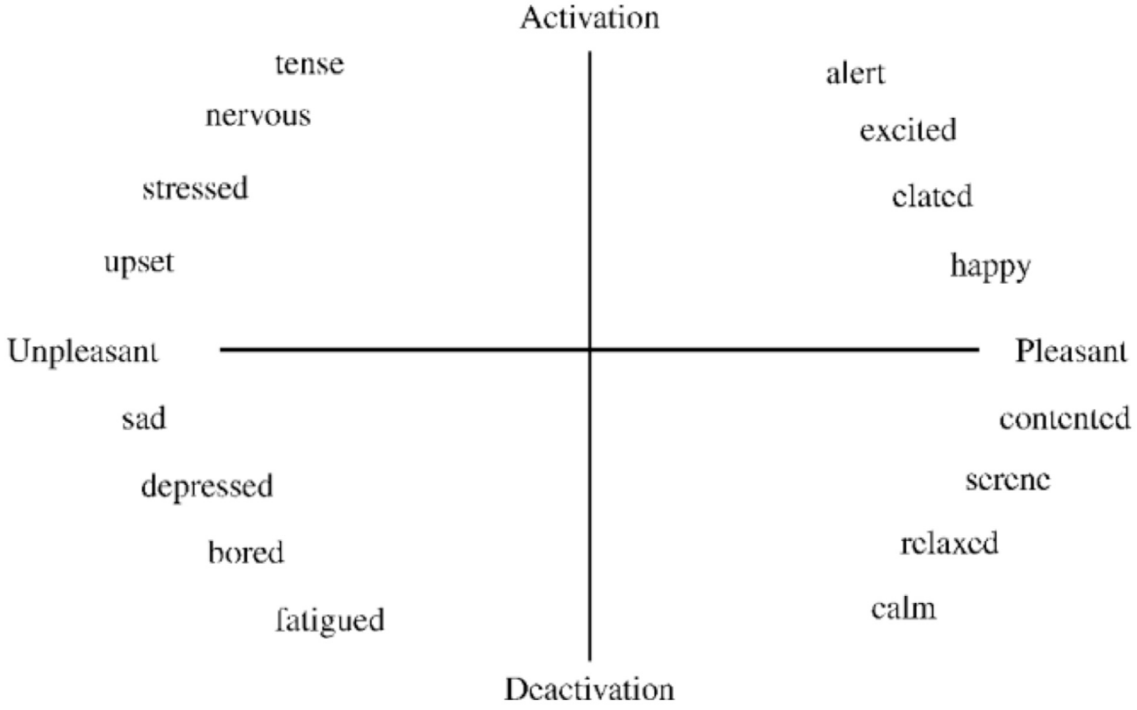
Emotion research can take a valence-based approach (distinguishing between pleasant and unpleasant emotions) or can involve looking into discrete emotions (distinguishing specific emotions). It is important to study specific dimensions of emotions and not just valence, since different emotions with the same valence have been shown to trigger different behaviors.

Discrete emotion theory states that there are a few basic emotions (Tomkins, 1962), as described in the previous section. The recognition of each basic emotion is viewed to be the same across cultures and ethnicity, since emotional responses are considered to be biologically determined. According to discrete emotion theory, each emotion is measured along three dimensions: intensity, valence, and arousal. Intensity is measured on a spectrum from high to low, valence refers to pleasant/unpleasant, and arousal pertains to activation/deactivation. According to Berger and Milkman (2012), valence and intensity are not the only determinants of the way a person reacts to an emotion that is felt. Instead, if that emotion is also high on the activation or arousal scale, then it is a crucial antecedent for a decision. This finding is decisive for the way emotion research is conducted because it stresses thinking beyond the definition of positive vs. negative emotions and intensity.

While discrete emotion theory distinguishes valence, arousal, and intensity, the emotional circumplex differentiates 'only' between valence and arousal. The emotional circumplex sorts emotions along two axes, namely activation/deactivation and pleasant/unpleasant (Figure 1).

Discrete emotion theory as well as the emotional circumplex focus on certain dimensions that make up an emotion. Emotions classification according to the wheel of emotions is different. Plutchik proposes that some basic emotions interact with

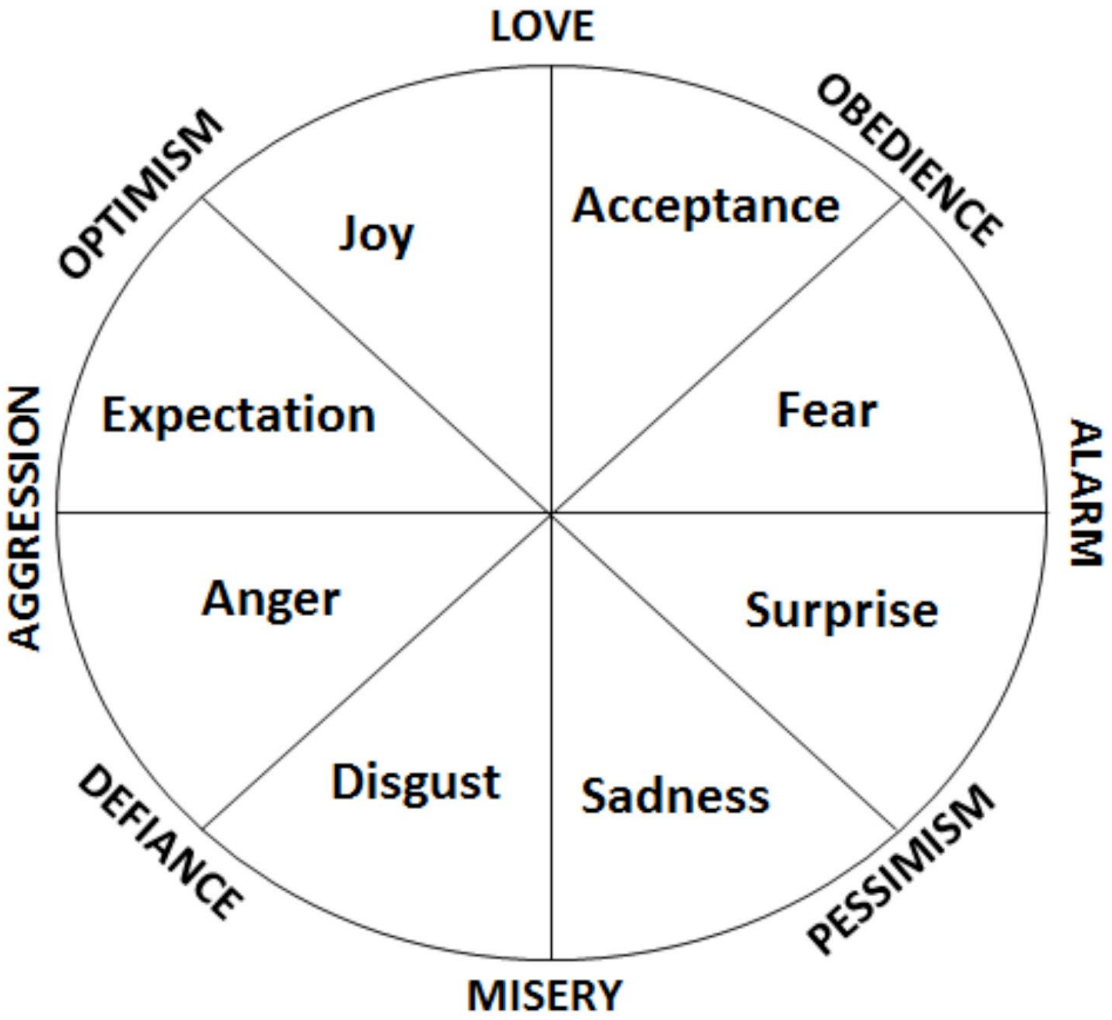
Figure 1. *The emotional circumplex (Russell and Feldman Barrett, 1999, p. 808)*



each other to create the remainder of emotions that can be found in social interactions (Plutchik, 1962). The Wheel of Emotion shows the basic emotion categories, their arrangement as bipolar dimensions, and the states produced by combining basic categories (Figure 2). The closer the emotions are positioned on the wheel, the more closely they are related. It is possible to mix two adjacent emotions, as well as those that are rather close to each other. The further the two emotions that make up a new emotion are apart, the more complex the new emotion gets. Emotions on opposite sides of the wheel cannot be combined, because the conflicting impacts would nullify each other.

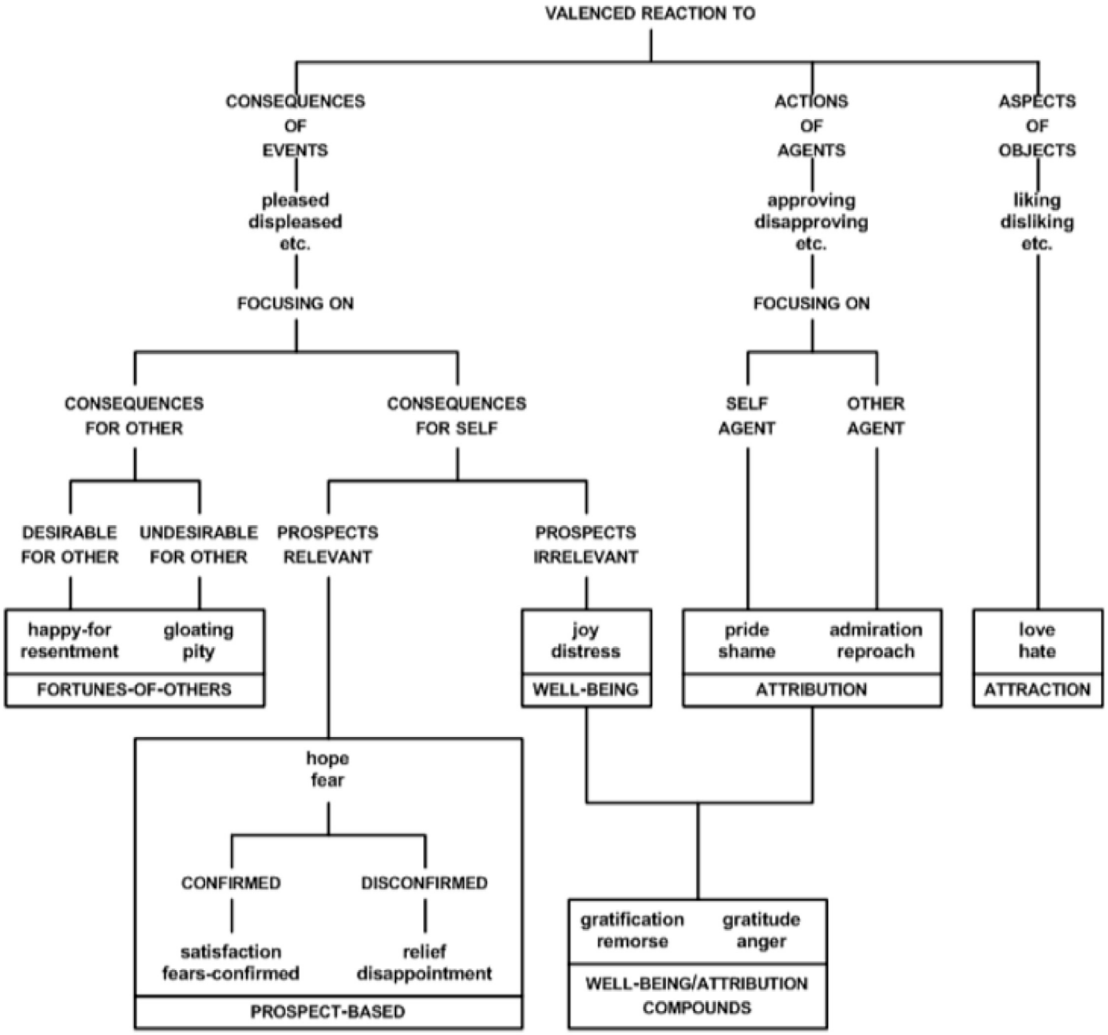
Ortony, Clore, and Collins (1990) do not believe in the concept of basic emotions and propose a different arrangement of emotions. They define emotions as valenced reactions as a consequence of an event (first category), a reaction to an action by an agent (second category), or a reaction to aspects of objects (third category). In the first category, the exact reaction evoked by the trigger depends on whether there are consequences for the self or others. The emotion that is the outcome of the process depends on whether the consequences for the self are relevant or irrelevant or on whether the consequences for the other are desirable or undesirable. In the second category, the reaction and emotion depend on the self as agent or the other as agent. In the third category, liking or disliking already leads of itself to the final reaction, namely attraction (Figure 3).

Figure 2: The Wheel of Emotion (Kellerman, 1977, pp. 40 and 42)



Where discrete emotions theory argues that there is a small number of core emotions, the appraisal tendency (ATF) is about how emotions arise. In this framework, emotions arise from evaluations of certain events. This focus on evaluations is what distinguishes the ATF model from the other models. One implication of this model is that emotions that belong to the same valence category; for example, fear and anger, which both have negative valence, can have a different impact on decision-making. Lerner and Keltner (2001), for example, show that fear leads to relatively pessimistic judgments and choices, whereas anger has been linked to relatively optimistic judgments and choices. Interestingly, angry and happy individuals react very similarly (Lerner & Keltner, 2001). The difference can be explained by the way angry and fearful people evaluate and appraise events. For angry people, upcoming events seem highly predictable and comprehensible (Lerner & Keltner, 2000). For fearful people, there is

Figure 3: The Cognitive Structure of Emotions (Ortony, Clore & Collins, 1990, p. 19)



an opposite pattern: upcoming events seem highly unpredictable and incomprehensible (Lerner & Keltner, 2000).

Several other studies have found that systematic processing is more likely in case of negative emotional states, while heuristic processing is more likely in positive emotional states (Batra & Stayman, 1990; Bless, Bohner, Schwarz, & Strack, 1990). A later stream of research looked at specific emotions and found a differentiating effect of two negative emotions. More specifically, sadness has been linked to systematic processing and anger to heuristic processing (Bodenhausen, 1993; Bodenhausen, Kramer, & Süsser, 1994; Lerner, Goldberg, & Tetlock, 1998).

It is important to note that, according to So, Achar, Han, Agrawal, Duhachek, & Maheswaran (2015), the effect of an emotion on behavior may differ depending on the decision context. They cite studies (Bushman & Baumeister, 1998; Herrald & Tomaka, 2002) where pride in one scenario leads to positive behavior, whereas it leads

in another scenario to aggression. It is therefore important to study the effect of emotions in each specific context and not overextrapolate from findings in other areas.

Looking more closely at economic behavior, Drouvelis and Grosskopf (2016) showed, in a public good game (where the total of amount of money is the largest if everyone puts in all of their the "tokens" to the pool) with induced emotions, that angry subjects contribute on average less than happy subjects. Andrade and Ariely (2009) showed that inducing happiness and anger has a transient effect on decision-making. More specifically, proposers who were angry made fairer offers to their respective partners in the second ultimatum game compared to happy proposers. And Raghunathan and Pham (1999) showed that in gambling decisions, sad individuals favor high-risk/high-reward options, whereas anxious individuals prefer low-risk/low-reward options. Differences have been attributed to the fact that different emotions convey different types of information to the decision-maker and prime different goals.

One study specific to the pension context is the neuromarketing study by APG (Bronner, 2016). This study looked at brain activity networks that have been linked to specific emotions. Based on this, a score was made of positive emotions (such as desire and trust) minus negative emotions (such as fear and danger) that people experience when confronted with both neutral and pension-related words. They found that words such as net pensions, investments, and coverage ratios score lower on the positive-negative emotions scale than neutral words. Visser, Oosterveld, & Kloosterboer (2012) showed that, aside from boredom, confusion and distrust, participants often report being powerless when it comes to impacting their pension situation. This leads to participants closing themselves off from information regarding their pensions. In a more positive light, the same research showed that people experience positive emotions when they feel knowledgeable about their pension situation, which ultimately results in a greater willingness to engage in pension planning. Another example is that anger about current social developments, such as the refugee crisis, as well as anger towards politicians and the financial sector in the Netherlands, negatively affects trust in the pension system (Motivaction, 2016). Eberhardt et al. (2016) revealed that retirement anxiety can encourage certain people to seek more information about their pension, while it may prevent others from doing so. A study by Nenkov, MacInnis, & Morrin (2009) looked at hope for financial security during retirement. They found that, for people with high hope, communicating a worse than expected chance of retiring with financial security increases the search for information.

3. Measuring Emotions

Measuring emotions is far from trivial. Researchers who want to investigate the role of emotions in retirement planning have a variety of techniques to measure emotions at their disposal, each with its own advantages and disadvantages (see Table 2). For example, emotions can be measured by recording bodily reactions (physiological measures of the nervous system), such as increase of the heart rate, facial reactions (expressive and motor behavior), or relying on self-reports or emotions revealed directly or indirectly in written text. But as Izard (1977) points out, while different parts of an emotion can be measured separately, they should be studied in combination in order to record and quantify the entire emotional process and experience. This section focuses on the different ways of measuring an emotion, with as central questions: what is measured, and how is it measured? Also, we list advantages and disadvantages for each of the techniques so that researchers who wish to measure emotions in retirement planning have an overview of the possibilities as well as of the challenges.

The Brain and the Nervous System

Brain. Electro-encephalography (EEG) and functional magnetic resonance imaging (fMRI) are examples of techniques used to measure brain activation. Measurement using fMRI is based on blood-flow changes as a proxy for energy consumption by brain cells. EEG measures electrical activity or, more specifically, changes in voltage levels caused by specific current within neurons of the brain.

Meta-analyses have been conducted on the link between discrete emotions (fear, disgust, sadness, and happiness) and activity in specific brain regions (Murphy, Nimmo-Smith, & Lawrence, 2003; Phan, Wager, Taylor, & Liberzon, 2002). However, it appears that an emotional state usually involves brain circuits and thus not so much brain regions in isolation (Kagan, 2007; LeDoux, 2000; Storbeck, Robinson, & McCourt, 2006). For example, the amygdala has been linked to fear stimuli (Murphy et al., 2003; Phan et al., 2002). Other studies, however, weaken this result, suggesting that the amygdala reacts not exclusively to the processing of fear but to unexpected signals that are motivationally relevant (Mauss & Robinson, 2009). Analogous to the emotion of fear, the emotions of disgust and to a lesser extent sadness seem to have some relation to specific brain activity (Murphy et al., 2003; Phan et al., 2002). Here also, there does not appear to be any causal link. Instead of studying emotion-related local brain activation, one can 'zoom out' and study left part versus right part of the brain activation related to emotions. Both EEG and fMRI studies have found that approach-related emotional states (e.g. anger and worry) are linked to activation

in the left part of the brain (Harmon-Jones & Allen, 1998; Harmon-Jones, Lueck, Fearn, & Harmon-Jones, 2006; Heller, Schmidtke, Nitschke, Koven, & Miller, 2002). Avoidance-related emotional states are linked to activation in the right part of the brain. Thus, compared to local brain activation patterns, more significant results are obtained for this hemispheric approach.

Advantages/Disadvantages. Because fMRI (as well as other neuro-imaging techniques) is better able to locate activation in specific brain regions compared to EEG. Neuro-imaging methods in general seem better capable of determining how certain emotions are reflected in the brain (Panksepp, 1998). This high precision of neuro-imaging techniques comes at a cost since these techniques are generally very expensive. Also, due to the lack of causal evidence, it is not clear in what exact way different emotions show in the brain.

Nervous system. The autonomic nervous system (ANS) regulates bodily functions such as the heart rate, digestion, and the respiratory rate. Two types of responses are commonly measured: electro-dermal (i.e., sweat gland) and cardiovascular (i.e., blood circulatory system).

When it comes to measuring electro-dermal responses, this often focuses on the skin conductance level (SCL). Measures such as the heart rate (HR) and blood pressure (BP) are used to quantify the cardiovascular responses. Some studies suggest that specific emotions go hand in hand with specific ANS activity. One of the findings by Ekman, Levenson, and Friesen (1983) was that heart rate increases more in anger and fear than in happiness. Another finding was that left and right finger temperatures increase more in anger than in happiness. These findings hold both for reliving emotions and for mimicking emotions via instructions on which muscles to contract. Stemmler, Heldmann, Pauls, and Scherer (2001, p. 284) found that the heart period for fear is shorter than for anger. Yet, other studies, such as Cacioppo, Berntson, Larsen, Poehlmann, and Ito (2000) claimed the effect of specific emotions on ANS activity to be inconsistent.

Advantages/Disadvantages. An advantage when it comes to measuring electro-dermal and cardiovascular responses is that the results are very reliable. However, pinpointing bodily reactions to specific emotions is difficult.

Observable Expressive Patterns and Behavior

This section focuses on emotion measurement through observable expressive patterns in the form of voice, facial expression, and body posture.

When it comes to voice, one can measure voice amplitude (loudness) and fundamental frequency (pitch). Several studies have found a link between vocal pitch and arousal. More specifically, it was found that a higher level of arousal is associated with a higher vocal pitch (Bachorowski, 1999). However, there is a less definitive link between vocal characteristics and discrete emotions or valence (Bachorowski, 1999). Facial expressions are measured via observer ratings, facial electromyography (EMG) or muscle action potentials (MAPs). Contrary to vocal characteristics, facial behavior appears to be sensitive to the valence of an emotional state (Russell, 1994). Note that a number of moderators, such as the absence or presence of an audience, probably play a role (Fernández-Dols & Ruiz-Belda, 1995; Fridlund, 1991; Kraut & Johnston, 1979)

Body posture is measured by having observers rate gestures. Not many studies have been devoted to body posture as a measurement tool for emotions. The body postures that did receive attention, however, were expansive versus diminutive postures, where the former is linked with pride and the latter with embarrassment. For a study on pride see, for example, Tracy and Robins (2004). For a study on embarrassment see Keltner and Buswell (1997).

Advantages/Disadvantages. An advantage of emotion measurement through observable expressive patterns is that the observer can detect subtle cues using his or her emotional intelligence. A disadvantage is that people can intentionally suppress otherwise visible emotional reactions.

Self-reporting

A fast (but subjective) way to directly express emotions is via self-reporting, where a person is asked to state the emotions experienced. This can be done via, for example, survey questions or an interview. When it comes to surveys, people can either be asked to list the emotions experienced (on a scale) or to indicate their emotions via pictograms of facial expressions.

Advantages/disadvantages. The principal advantage of this method is that it is not time-consuming and takes relatively little effort. However, people may either overstate or understate their emotions when they self-report on them. Events from the past may not be recalled in detail and thus not described accurately. Also, the

emotion vocabulary someone uses can differ substantially from that of another person. For example, it can happen that someone regards being angry and mad as one and the same emotion whereas someone else may interpret the emotions as distinct from each other.

Written text (verbal)

When people are asked to write a short text about what they have experienced, they typically express their emotions indirectly. In that case, identifying these emotions can be automated via a variety of measurement techniques. This section covers methods to infer emotions from text, starting with addressing the question why written texts are popular for emotion measurement.

Ortony, Clore, and Foss (1987, p. 342) mention that emotions and linguistics are different concepts, but that studying emotions via language is the most accommodating way to learn more about them. The words someone uses say much about that person as well as about the person's psychological state (Pennebaker, 2011; Tausczik & Pennebaker, 2010). This is why written texts have become the focus of many research studies. Mossholder, Settoon, Harris, and Armenakis (1995) pointed out that written texts come in a variety of forms, such as written answers to survey questions or interview transcripts where the exact form depends on the design of the study. The 'big data' era accounted for the large number of tools that has been developed to analyze numerous documents in a short amount of time.

Textual data analysis (TDA) is the broad name for the systematic analysis of written text. Text data mining usually includes several sub-processes such as entity identification or detection of sentence parts. One of the sub-processes is what is called sentiment analysis. Sentiment analysis is sometimes also called opinion mining because it tries to extract the writer's feelings about a subject or entity.

While some textual data analysis tools can extract specific emotions, other tools extract merely valence. Examples of tools that do not go beyond an analysis of valence are IBM Social Media Analytics, Meaning Cloud, and SAS Sentiment Analysis. The functions of these tools include sentiment analysis, keyword extraction, and concept tagging.

An example of a tool that can analyze specific emotions is Linguistic Inquiry and Word Count (LIWC). LIWC first counts the number of words in a given text; the result for each category is then presented as a percentage of the total number of words. LIWC can thereby measure positive emotions (percentage of all positive emotion words in relation to the total number of words). More specifically negative emotions that can be studied with this tool are anger, anxiety, and sadness (Cohn, Mehl, & Pennebaker,

2004). Advantages of this tool are that a wide variety of categories (such as linguistic and psychological processes) can be analyzed aside from a few discrete emotions.

In terms of techniques and algorithms, two approaches can be distinguished: supervised methods and corpus/lexicon-based methods. Supervised methods try to give meaning to text via machine learning techniques that establish a model from training data and subsequently apply this model to data that is not trained (Gezici, Yanikoglu, Tapucu, & Saygın, 2012). The corpus-based method relies on a structured set of texts to check for words or linguistic expressions and their meaning. Some are general corpora, such as WordNet, MPQA corpus, and General Inquirer, while some are specifically intended for emotions, such as the Dictionary for Affect in Language (DAL), Affective Norms for English Words (ANEW), and the WordNet-Affect (Aman & Szpakowicz, 2007; Mossholder et al., 1995). Once it has been decided which corpora to use, an algorithm is then applied for emotion extraction. The NaiveBayes method is the most frequently used algorithm, but there are others such as the C4.5, Decision Tree, and SVM (Support Vector Machines) algorithms that can be used for this purpose (Quan & Ren, 2010). All of them classify emotions into different categories in different ways, leading to different classification accuracies.

Advantages/Disadvantages. An advantage of collecting data in the form of self-reporting is that the costs of obtaining the data are much lower as compared to, for example, neuroimaging techniques. Moreover, it is much easier to obtain large samples since the digital world has made it easier to both store and collect data in the form of tweets or weblogs. Also, algorithms can be applied on a wide variety of texts. However, people may either overstate or understate their emotions when they self-report on them. Events from the past might not be fully recalled and thus not described accurately. Also, the emotion vocabulary that someone uses can differ substantially from that of another person. What is more, only pre-coded emotions can be detected and not subtle expressions or sarcasm.

To summarize, there are various methods to measure emotions, each with its own advantages and disadvantages. In the next section, we review several examples of studies that we have conducted recently, which examine the role of emotions in the pension context.

Table 2: Emotion Measurement Methods

Subcategory	Technique	Advantages	Disadvantages	Reference
Category: Physiological measures of the nervous system				
Occurrences in brain	Electro-encephalography (EEG), functional magnetic resonance imaging (fMRI), and positron emission tomography (PET)	- Reliable results - Widely applicable	- High technological requirements - No subjective evaluation of experience - Pinpointing brain and nervous system reactions to specific emotion is difficult	Izard, 1992; Feldman Barrett, Lindquist & Gendron, 2007; Mauss & Robinson, 2009
Circulatory system	Cardiovascular imaging heart rate (HR), blood pressure (BP), total peripheral resistance (TPR), cardiac output (CO), and heart rate variability (HRV)			Feldman Barrett et al., 2007; Kreibig, Wilhelm, Roth & Gross, 2007; Mauss & Robinson, 2009
Respiratory system	Respiratory rate, inspiratory flow, tidal volume and its variability			Kreibig et al.,2007
Category: Expressive and motor behavior				
Facial expressions	Observer ratings, facial electromyography (EMG), and muscle action potentials (MAPs)	- Observer's emotional intelligence can detect subtle cues	- People can suppress visible emotional reaction intentionally - Emotional intelligence is necessary to detect emotions.	Izard, 1992; Feldman Barrett et al. 2007; Cohen, Pham & Andrade, 2008; Mauss & Robinson, 2009
Voice	Voice amplitude (loudness) and fundamental frequency (pitch)			Mauss & Robinson, 2009
Gestures	Observer ratings			Mauss & Robinson, 2009
Category: Self-Report				
1. Survey 2. Conversation	1. Questionnaire (directly expressed emotions) 2. Interview (directly expressed emotions)	- Only way to get subjective evaluations - Easy to administer - Used in many research areas - Often combined with other techniques	- Recall bias - Modification of answers because of social desirability	Mauss & Robinson, 2009; Malhotra, 2010
Category: Written text (verbal)				
1. Text mining plus opinion mining 2. Beyond Valence Sentiment Analysis	Textual data analysis	- Only way to get subjective evaluations - Easy to administer - Used in many research areas - Often combined with other techniques	- Recall bias - Modification of answers because of social desirability	Mauss & Robinson, 2009; Malhotra, 2010

4. Overview of results from recent studies on emotions in the pension context

In this section we present the results of three studies about the role of emotions in retirement decisions that were recently conducted in our research group.
Linden (2016) conducted a textual data analysis regarding emotions on written essays about personal retirement. The sample consisted of 157 master's students from Maastricht University aged 20 to 31. This particular demographic group was chosen because students would be entering the job market within the next year, meaning that the topic of saving, pension and retirement would become relevant for them.
In experimental sessions of one hour, respondents received an imagination task to engage them to think about their retirement. The respondents were then prompted to write a short essay about their thoughts and feelings regarding retirement. The essays were analyzed using Linguistic Inquiry and Word Count 2015 (LIWC 2015) software. This involved measuring what fraction of words within each essay could be classified as emotional. The results of the analysis revealed several interesting findings. First, the essays were twice as emotional compared to an average piece of personal writing. This confirms that emotions are relevant in the retirement context. Second, most essays contained a mix of both positive and negative emotions. Examples of both positive and negative emotional quotes can be found in Table 3. Respondents generally wrote more positively about retirement, possibly due to the education level of participants in the sample and their belief of having good job prospects. Respondents were also asked how they felt when writing the essay. The answers reflected confrontation and thoughtfulness, but also worry and fear. This shows that directly asking about emotions can lead to different emotions or a different intensity of emotions compared to indirectly inferring emotions from text.

Table 3: Quotes from essay writing

Positive	Negative
I will be very **happy** because nothing is obligatory. You just decide on what are you going to do each week or day, not too much planning and obligations.	I think that being retired is kind of **sad**, since you are moving towards the end of your life.
I **like** retirement, because I finally have time to do the things I enjoy: my hobbies, participating in sports, and hanging out with friends.	But then I also feel **insecure**, if I will be able to do all that I want.
The first thought which came to mind regarding retirement was a **calm and peaceful** view of an old man sitting in his garden in his favorite chair.	I guess I will have a lot of spare time. Therefore, I am **afraid** that I will get bored after a long working life.

In another study that applies self-reports of emotions, Horst (2017) investigated emotions associated with uncertainty in long-term financial planning. Although uncertainty is often researched as a unitary construct, it can take on different forms in qualitative terms, depending on the context or the individual. One way of categorizing uncertainty is by distinguishing between epistemic and aleatory uncertainty. Epistemic uncertainty arises from the decision-maker's lack of knowledge or expertise. A person may feel uncertain when considering a trivial question, such as whether one country is larger than another, because the person does not know the sizes of the respective countries. Aleatory uncertainty, on the other hand, arises when the outcome of an event is stochastic in nature, such as the uncertainty around the outcome of a flip of a coin.

In the pension context, a decision-maker must consider several factors that can be perceived as inherently more aleatory or epistemic. For example, determining how much money should be set aside for retirement each month requires insights about future income needs, expected retirement age, and financial resources available for savings. With the help of research, financial advice, and planning tools, one can make relatively accurate estimates. On the contrary, even a well-informed person would not be able to predict the investment performance of a portfolio with 100% accuracy, as returns on investment depend on random factors in the environment. Furthermore, the perceived uncertainty regarding pensions and pension planning is not necessarily the same across the population: one individual may experience predominantly epistemic uncertainty, while another may experience aleatory uncertainty.

Based on this theoretical framework, Horst (2017) examined the effects of epistemic and aleatory uncertainty in long-term financial decision-making and the effect on emotions. The link between uncertainty and emotions has been established in previous research, thus Horst's research aimed to pinpoint which emotions were activated by the two types of uncertainty in the pension context. Using an online survey, 351 participants between the age of 25 and 65 employed in the United States were asked to write a short essay about their thoughts and feelings on pensions and pension planning. Following this task, the participants were prompted to rate to which extent they felt certain emotions while writing their essay, on a scale from 1 to 7. As in Linden's (2016) study, primarily negative emotions were investigated, such as anger and fear. However, happiness and excitement were included as well, considering that these positive emotions are often related to retirement.

Regression analyses were used to study which emotions were activated by the two different types of uncertainties, while controlling for demographics and other factors such as risk attitude, propensity to plan, and subjective knowledge about pensions.

Horst (2017) found that, in general, individuals who perceive uncertainty as predominantly aleatory are more emotional than those who perceive uncertainty as epistemic, as the former was found to activate a greater number of emotions.

More specifically, the author reported that aleatory uncertainty is associated with arousing emotions of mixed valence such as fear, irritation, and excitement, whereas epistemic uncertainty is associated with happiness. A possible explanation for the activation of fear and excitement is the feeling of powerlessness that may arise from an outcome beyond one's control in an event that is stochastic in nature. Consumer research provides example of individuals feeling powerless when thinking about retirement (Visser, Oosterveld, & Kloosterboer, 2012). Furthermore, these results indicate interesting implications for the different behavioral reactions under uncertainty. Research has found that uncertainty leads to decision-makers relying more on emotions as input factors for a decision (Faraji-Rad & Pham, 2016). Taking excitement as an example, this emotion has the potential to stimulate behavior (Mauss & Robinson, 2009). Emphasizing the positive possibilities of retirement, excitement within an individual about the prospect of retiring can encourage greater engagement in pension planning.

We, Perik, Brüggen and Post (2017), the authors of this paper, studied emotions among a representative UK sample in the age category of 30 to 65. In total, 779 respondents participated in an online survey conducted by Research Now. The main research question was whether emotions can explain the variation in behavioral intentions over and above cognitive factors. Emotions were measured via both closed and open-ended questions. The closed questions covered the basic emotions: anger, anxiety, sadness, happiness, and surprise. In the open-ended questions, respondents were asked to answer the following questions about their retirement: What do you see? What do you look like? Describe your lifestyle. What concerns or worries (if any) do you have? What pleasant or enjoyable things (if any) are you thinking about? What emotions do you experience when you think about retirement? How old are you in this experience of retirement that you are thinking about?

The study also included a variety of cognitive factors such as financial literacy and subjective knowledge, but also beliefs about expected retirement age and health conditions in retirement.

Next, we, Perik, Brüggen and Post (2017) regressed a measure of behavioral intentions[2] (BI) on different sets of explanatory variables[3]. When regressing BI only on demographics and cognitive factors, the resulting adjusted R2 is 0.42. When regressing BI only on emotions, the resulting adjusted R2 is 0.25. Thus, emotions alone can explain a great deal of variation in BI. When adding emotions to the set of cognitive and demographic factors, it was found that the model has an even higher adjusted R2 of 0.47. Thus, emotions explain BI over and beyond demographic and cognitive factors.

In addition, in the full model we found a positive relationship between anxiety, happiness, and surprise on behavioral intentions and a negative relationship between anger and behavioral intentions. The results of anger and anxiety were in line with Lerner and Keltner (2001), while the finding of happiness was not. We found that fear is linked to optimistic choices, whereas anger and happiness are linked to pessimistic choices. Lerner and Keltner (2000) explained the results by how people evaluate certain events. For people who experience the emotions of anger and happiness, upcoming events seem to be associated with predictability and comprehensibility. For people who experience the emotion of fear, the opposite seems to be the case, i.e. events are regarded as unpredictable and incomprehensible. The positive correlation between anxiety and behavioral intentions may thus have to do with the lack of predictability of the pension context. This positive correlation is in line with the finding of Eberhardt et al. (2016) that retirement anxiety can encourage certain people to seek more information about their pension. We also found that the intensity of experienced emotions differs depending on demographic characteristics. For example, for the older age group we found positive emotions to be more intense and negative emotions less intense. This is in line with the more general finding that

2 The instructions or questions were: (1) how big is the chance that you will look at your pension situation? (2) check the balance of your retirement account(s); (3) discuss your retirement finances with friends or family; (4) speak with a professional financial advisor; (5) make use of education materials on retirement savings offered by your employer; (6) read information on the internet about finances or pensions so you can understand the topic better; (7) spend time planning or making additional savings for your retirement (e.g., outside of the pensions that you already have); (8) take steps to spread your retirement savings across more types of investment; (9) open a savings account for retirement; and (10) look up information about your pension. The average across all items in the analyses was used.

3 Emotions: anger, anxiety, sadness, happiness, and surprise. Demographic factors: age, gender, income, marital status (dummy: partner, yes/no taken up in regression), employment status (dummy for self-employed and being retired taken up in regression), part-time versus fulltime work, and education. Cognitive factors: financial well-being, beliefs, subjective knowledge, time preferences, risk preferences, propensity to plan, and financial literacy.

older people seem able to regulate emotions better (e.g. Gross, Carstensen, Pasupathi, Tsai, Götestam Skorpen & Hsu (1997)). Another finding was that men with higher income experience emotions a bit more intense. Thus, the link between emotions and behavior may be stronger or less strong depending on demographic characteristics or context. The role for future studies is to find out under which circumstances and for which demographic groups anxiety prevents or instead stimulates taking action.

5. Summary and Discussion

We recognized the importance of studying emotions in the following ways. First, we created an overview of the different views on what an emotion is and provided a definition of emotions. While we realize that different authors suggest different definitions, most viewpoints were captured once the following components were integrated: the brain and nervous system, observable expressive patterns, and the experience or conscious feeling of an emotion.

Second, we distinguished between basic and non-basic emotions. There is no agreement on a universal list of basic emotions. However, the emotions often mentioned are happiness, sadness, fear, and anger. Compounding of two or more of these basic emotions leads to non-basic emotions.

Third, we determined that two strands of literature exist on the effect that emotions have on behavior. The first strand of literature distinguishes between positive and negative emotions and argues that positive emotions trigger different actions than negative emotions. More recent literature studies the effect that specific emotions have on behavior. We provide multiple examples of behavior in general and of economic behavior.

Fourth, each of the different components of an emotion potentially asks for a different type of measurement. An advantage of using a neuroimaging technique is its high precision. However, this technique also has some disadvantages. The first one is the high costs involved. The second one is the difficulty of pinpointing how a specific emotion is reflected in the brain. An advantage of measuring emotions via observable expressive patterns is that computers can analyze the data. A disadvantage is that people can intentionally suppress an emotional reaction. The third category is self-reports, which has the advantages of low costs in the data collection process and the ease of collecting large samples. A disadvantage is that people may not accurately describe emotions (or their intensity) when self-reporting on them.

We illustrated with a couple of studies that emotions are important for retirement-related behaviors. For example, we touched upon how the emotions of fear and anger lead to differences in risk-taking and how negative and positive emotions relate to systematic and heuristic processing. The findings of several other studies, which focus specifically on emotions around the topic of pensions and pension planning, highlight the promising role of emotions in this context. As an example, aleatory uncertainty was linked with negative emotions in one of the studies. Even though this type of uncertainty cannot be removed, uncertainty as such should be minimized with the goal of reducing negative emotions.

With our survey paper, we hope to facilitate future research on the link between emotions and behavior, specifically long-term financial decision-making (e.g., in the pension context). An important question that we carve out is under which conditions certain emotions occur. We already saw that emotions (and their intensity) may differ depending on demographic characteristics such as gender and age. Also, emotions may vary, as seen when studying different subdomains of the pension context such as income, health status, or the amount of free time during retirement. Moreover, contextual factors, such as a change in pension entitlement, can impact emotions. In the introduction, we saw that the media, when reporting on these contextual factors, generally do so with a negative emotional undertone. Communication by pension funds should focus on reducing negative sentiment and carefully pre-testing planned pension communication to identify which emotions are stimulated.

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