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# Ambiguity attitudes to explain willingness to discuss ACP

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## Abstract

The lack of conversations held on advance care planning (ACP) is a concerning problem in health care. The outcome for multiple parties, such as physicians, family members, and the patient is compromised if ACP is not discussed. In this paper, it is hypothesised that ambiguity aversion and a-insensitivity are correlated with the willingness to discuss ACP. The indices for the ambiguity attitudes are measured through the elicitation method developed by Baillon et al. (2018). A survey is used to gather data on the level of willingness to discuss ACP, and other variables. An OLS regression is used to analyse the data. Based on this dataset, no evidence can be found on whether the willingness to discuss ACP can be explained by ambiguity aversion or a-insensitivity. The validity of the indices that measure the ambiguity attitudes is questionable, as they are not obtained within the domain of interest. Furthermore, it was difficult to capture their risk perception and degree of perceived ambiguity in discussing ACP, as such variables are obtained introspectively, rather than observing their behaviour. Other research on this topic has focused on specific cultural groups, which can be recommended when tackling this research question. A priori research on the sample size could make this study more effective, as one would be able to omit the observations where the loved ones have thought about ACP, since it can be argued that people who have never thought about ACP should be targeted.

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# Introduction

Advance care planning (ACP) is defined by 'the act of discussing the process of End-of-Life (EoL) care, while also documenting their preferences for potential treatments and medical orders, in the form of advance directives (AD)'. By being aware of one's fate and the whole process that surrounds it, one ensures themselves of a certain autonomy, which can lead to greater fulfilment of physical, emotional, social and spiritual needs (Department of Health, 2008). Being confident in the choices one makes with regard to treatment options can be beneficial to physicians; it would provide them a situation which they can judge better, leading to better patient outcomes (IOM, 2015). As a result, communication between physicians and the social environment of the patient would likely see an improvement as well (Curtis & Engelberg, 2011). Furthermore, the loved ones of the patient would be better able to prepare for grief, if they have had discussions on ACP (Martin et al., 1999). Knowing how one dealt with such a vague and abstract concept can help to cope with the pain that is associated with their death, which can mitigate symptoms of depression and anxiety (Detering et al., 2010). Lastly, engaging in conversations on ACP leads to more stable preferences in treatment options, which can be beneficial if illnesses develop to a stage in which communication is not effective anymore (Auriemma, 2014).

Even though the benefits of discussing ACP are apparent, and many people claim to find it important that they should discuss it, a quarter of the people aged 75 years or older have given little to no thought on this matter, while more than a quarter have not stated their preferences in AD, nor did they have any meaningful conversations on the topic before (Clements, 2009). In a Californian survey (CHCF, 2012), where they investigated the attitude towards ACP across all ages, it was reported that most people were avoidant on ACP, because of the nature of the matter, or because they felt that they had too much on their plate. Other common reasons to avoid discussing ACP are apathy, or the belief that what is decided upon would upset the family, or that the family should decide what the course of action is (Miles, 1996). To support the people who find difficulty in formulating thoughts on ACP, they should be encouraged by highly trained personnel within the health institutions, who supervise and help patients to complete AD. Studies have shown that encouragement through this method is effective in the completion of AD, and thus helpful in the process of ACP (Emanuel et al., 1991). However, these methods are often resourceful, ungeneralizable and infeasible in clinical practise (Pearlman, 1995). Another intervention type that is proposed and utilised, would be education. The studied educational programs were found to be useful, however were missing some components vital to ACP. For example, treatment options and patient outcomes were not vividly described, or the program was not flexible to accommodate for different learning styles and personalities, while guidance to communicate wishes to their family members and health care providers was limited (Pearlman, 1995).

To increase ACP among patients, numerous theoretical models of behavioural change have been proposed and applied. The trans-theoretical approach, as proposed by Prochaska and DiClemente (1983), which they used to identify self-change in smoking habits, can be of help to increase the number of patients completing their AD (Pearlman, 1995). This model assumes ten processes of change in five different stages. Each stage emphasises a different process of change. Stage one is characterised by pre-contemplation. Not being aware of the need of, or unwilling to give thought to ACP are roadblocks which are recognised by this model. Then, in stage two, doubt should arise whether one should complete their AD. In the first two stages, the emphasis lies in creating awareness of the need of ACP. In stage three, the patient is intending to complete AD, and looks into potential treatment options. Although educational programs still need to see improvement, the availability of them would support the patient in this stage. Stage four is defined by action, that is, the completion of the AD. An initiative like *Respecting Choices* (1991) assisted individuals who were willing to complete their AD. In stage five, the patient is willing to continue discussions on ACP, and looks to update their AD when necessary. One could imagine that patients would turn to their physicians in this stage. Assuming that the patient has a greater frame of reference compared to earlier stages, such discussions should run efficient and smoothly. This model recognises the complexity of ACP, and offers room to individuals to have different engagement levels at different stages in the process.

To be effective in stages one and two, creating awareness seems to be the key. *Respecting Choices* has been outstanding in this practice, and has also been successfully assisting individuals in completing their AD and guiding the process of ACP. In almost all cases, AD were found in the medical file of patients who participated in the program (Hammes and Rooney, 1998). What made this program well-known, is how they refocused the discussion of treatment preferences from autonomy towards personal relationships. Through questions as 'how can you guide your loved ones to make the best decisions for you?', people were navigated towards a different perception on the situation (Prendergast, 2001). Similarly, the president's council on Bioethics (2005, p. xix) noted that a process based on autonomy would put 'major ethical weight to personal autonomy, choice and personal pride in self-sufficiency. But in doing so, it deliberately ignores the truth of human interdependence and of our unavoidable need for human presence and care.' One of the main challenges of the *Respecting Choices,* as mentioned by their program leader Bernard Hammes (2003), is the effectiveness in other culturally diverse regions in the United States. This problem has been a recurrent one, as other community-based initiatives faced similar criticisms.

Considering that personal relationships have increasingly been a more important aspect in ACP, one could reason that family members can be an ideal starting point to acknowledge and understand the need of ACP. Carr and Luth (2017) reviewed the strengths and weaknesses of the policy on ACP in the US. In their paper, they mentioned how relatively little research has been conducted on the efficacy of

End-of-Life care conversations. Identifying which factors are associated with meaningful and productive conversations among family members can help evaluate the current system. Doukas and Hardwig (2003) argue that the AD of a patient can have great meaning to their family as well. They acknowledge the role of the family in the process of ACP, and argue that the interaction with the physician can be enhanced through discussions on this topic. In their research, they envision how family ties can be used to improve patient outcome through the discussion of potential scenarios. By incorporating a family member into the ACP discussions, they can not only help to guide the patient through distress, but also assist the physician in decisions that would suit the wishes of the patient, in the event that the patient cannot effectively communicate them anymore. Furthermore, they also mention that not all people are positively affected by such conversations, which can lead to a delay of the process of ACP, or even complete disengagement. They argue, however, that they still need to be made aware how important it is to know who is in charge of medical decision-making when they are not able to anymore. Having that in place can improve the interaction with the physician, as argued by Burkle et al. (2012) as well. In the evaluation of external factors and perceived patient's preferences on physician's decision for treatment, physicians are forced to interpret an ambiguous situation when clarity on how to treat in an end-of-life stage is not provided, due to a discrepancy between family's wishes and the patient's AD. Smoothing out this issue and thus creating a more reliable system would improve the outcome for all parties involved.

In this paper, an attempt is made to understand what mechanism would prevent family members from discussing ACP. More specifically, it is investigated whether ambiguity attitudes play a role in the willingness to start the conversation on ACP, with the goal to create awareness on the topic. For the purposes of this research, it is assumed that the people around the person who needs to put thought into ACP are the ones who are initiating the discussion. To research whether ambiguity attitudes affect this context, two indices are used (Baillon et al., 2018). One index, ambiguity aversion, is considered to be normative. This measures how much a person likes or dislikes ambiguity. It is said that it captures an emotional component, while the other index, a-insensitivity, measures how a person perceives ambiguity, which can be denoted as a cognitive component. It captures to what extent the person regresses towards fifty-fifty. In other words, the more a-insensitive a person is, the less likely a person differentiates between the probabilities of events. Even though the probability of a certain outcome is significantly higher than the probability of another outcome, an a-insensitive person would still perceive the probabilities as equal.

Whether one decides to initiate a discussion on ACP, or to keep waiting until their loved one is assertive in this aspect, is met with probabilities one is not certain about. How one perceives ambiguity can have an impact on the willingness of discussing ACP. To understand how ambiguity affects this context, one needs to analyse how the indices ambiguity aversion and a-insensitivity relate to the risk that one

associates with discussing ACP. Perceiving the situation as high risk would mean that one believes that discussing ACP has a high chance leading to a negative outcome. This outcome could range from an awkward dinner, to serious damage to their relationship, or a delay in the process of ACP. Perceiving it as low risk would similarly mean that such outcomes would not be expected. This would yield the following hypotheses:

**Hypothesis 1:** People who perceive discussing ACP as an ambiguous high risk situation and are a-insensitive, are more likely to be willing to engage in conversations on ACP compared to their a-sensitive counterparts.

**Hypothesis 2:** People who perceive discussing ACP as an ambiguous low risk situation and are a-insensitive, are less likely to be willing to engage in conversations on ACP compared to their a-sensitive counterparts.

**Hypothesis 3:** People who are averse to ambiguity and view discussing ACP as an ambiguous situation, are less likely to be willing to engage in conversations on ACP, compared to people who are less averse to ambiguity.

## Methodology & Data

The elicitation method proposed by Baillon et al. (2018) is used in this paper to measure whether subjects are deviating from ambiguity neutrality. Ambiguity neutrality would mean that a person is sensitive to different probabilities of events, and has a neutral attitude towards ambiguity. The index ambiguity aversion measures how much a person is ambiguity averse, or ambiguity seeking, while the index a-insensitivity measures how much a person is sensitive towards the perceived degree of ambiguity, meaning whether they can differentiate between events which have different probabilities. The ambiguity attitudes are measured through two indices. To illustrate, subjects are asked whether they prefer bet 1, €20 under event E, or bet 2, €20 with probability m. If $p = 0$, subjects will always choose bet 1. If $p = 1$, subjects will always choose bet 2. Under event E, matching probability is defined when bet 2 is chosen for a certain probability m. On the next page, Table 1 shows the various bets which are used for this research.

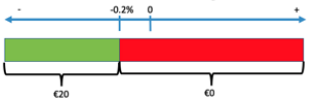
Table 1. Elicitation method of Baillon et al. (2018), using an interval of 0.2 percentage change

| | Win €20 if the AEX | Win €20 with probability p |
|---|---|---|
| $\boldsymbol{E_1}$ | Decreases by strictly more than 0.2% | Choose any p |
| $\boldsymbol{E_2}$ | Either decreases or increases by less than 0.2% | Choose any p |
| $\boldsymbol{E_3}$ | Increases by strictly more than 0.2% | Choose any p |
| $\boldsymbol{E_{12}}$ | Either increases by less than 0.2% or decreases | Choose any p |
| $\boldsymbol{E_{23}}$ | Either decreases by less than 0.2% or increases | Choose any p |
| $\boldsymbol{E_{13}}$ | Either decreases or increases by strictly less/more than 0.2% | Choose any p |

To measure the a-insensitivity index, let $m_i = m(E_i)$ & $m_{ij} = m(E_{ij})$. To calculate the average single-event matching probability, let $\mu_s = (m_1 + m_2 + m_3)/3$. For the calculation of the average composite-event matching probability, let $\mu_c = (m_{12} + m_{23} + m_{13})/3$. The a-insensitivity index is as follows: $a = 3\,(\frac{1}{3} - (\mu_c - \mu_s))$. If $\mu_s = \mu_c$, then maximal a-insensitivity is reached, meaning that a = 1. In this case, low probabilities would be overvalued, while high likelihoods are undervalued. Events cannot be differentiated based on their probabilities, meaning that an event is chosen at random. With perfect discrimination, the measurements would yield $\mu_s = \frac{1}{3}$ and $\mu_c = \frac{2}{3}$. In this scenario, someone would be a-sensitive, which would give a = 0. When a person is a-sensitive, they are able to differentiate between probabilities in events. For descriptive purposes, it is possible to have negative values, with a minimum at a = -1. Using the same values, ambiguity aversion is calculated through the following formula: $b = 1 - \mu_c - \mu_s$. Under ambiguity neutrality, the matching probabilities would take the following values: $\mu_s = \frac{1}{3}$ and $\mu_c = \frac{2}{3}$. This would yield b = 0, which would mean that a person has a neutral attitude towards ambiguity. If the matching probabilities of all events equal 0, one would be maximally averse towards ambiguity, meaning b = 1. Someone is maximally ambiguity seeking when the matching probability for all events are 1, where b = -1. For ambiguity neutrality, the two indices would be valued at a = 0 and b = 0. The indices are orthogonal, meaning someone can have a neutral attitude towards ambiguity (b = 0), but is a-insensitive (a = 1).

Figure 1. Choice bet #1

**For each value of p, please state your preference between option 1 and 2 (choice bet #1 out of #6)**

| | Option 1 (given probability option): You win €20 with probability p, and nothing otherwise | Option 2 (AEX option): You win €20 if the AEX index decreases strictly more than 0.2% **within 24 hours**, and nothing otherwise   |
|---|---|---|
| p = 0% | ○ | ○ |
| p = 1% | ○ | ○ |
| p = 2% | ○ | ○ |
| p = 5% | ○ | ○ |
| p = 10% | ○ | ○ |
| p = 15% | ○ | ○ |
| p = 20% | ○ | ○ |
| p = 25% | ○ | ○ |
| p = 30% | ○ | ○ |
| p = 35% | ○ | ○ |
| p = 40% | ○ | ○ |
| p = 45% | ○ | ○ |
| p = 50% | ○ | ○ |
| p = 55% | ○ | ○ |
| p = 60% | ○ | ○ |
| p = 65% | ○ | ○ |
| p = 70% | ○ | ○ |
| p = 75% | ○ | ○ |
| p = 85% | ○ | ○ |
| p = 100% | ○ | ○ |

Using Qualtrics, an online two-part survey was created. In the first part, respondents are asked how they view the bets. This part provides values that can be used in measuring the indices. Figure 1 above shows a choice bet that was presented to the subjects through Qualtrics. In the appendix, the other diagrams are shown. In the second part, they are asked whether or not they would discuss ACP after reading a scenario why ACP could be helpful. This question on willingness to discuss ACP is then followed up by questions that measure their subjective probability on the matter, which are used as proxy for their risk perception. One of the risk questions, the one on whether it is believed a discussion on ACP would damage the relationship with their loved one, is restated, but this time the respondents are asked how confident they are about the answer they had given. This answer provides a proxy for their ambiguity towards the situation. Besides indices for their ambiguity attitudes and their perceived risk and ambiguity on the situation, there might be other factors that influence the willingness to initiate conversations on ACP. For example, if a person has a better relationship with their loved one, it would be expected that they have a greater possibility of discussing ACP and judge the situation to be less negative than someone who has a bad relationship with their loved one. Thus, questions are asked on whether the conversations held with their loved one are found to be meaningful, and whether they feel understood by them. Furthermore, one could reason that people who recently have encountered loved ones passing away after being terminally ill or who are in palliative care, are more likely to have put thought into ACP, leading to a better understanding of the importance of ACP. Furthermore, people are asked about their age and gender. The answers of these questions are used as control variables. The entire survey can be found under Table A.2.

To study the mechanism proposed in this paper, an OLS regression is used. This method allows to analyse the effect multiple variables on the outcome. Below, the outcome variable and specifications are discussed. The willingness to initiate the discussion on ACP is scaled from 1 to 5, with 1 being the least willing to discuss ACP, and 5 being the most willing. The level of a-insensitivity, as measured through the elicitation method by Baillon et al. (2018), is valued from -1 to 1. Similarly, the index that denotes ambiguity aversion can also be valued from -1 to 1. The variable that addresses the perceived risk someone has on discussing ACP, is scaled from 3 to 9, with 3 being the least risky and 9 the most. These points are summed up after 3 questions on their risk perception of the situation. Ambiguity is scaled from 1 to 4 with 1 being completely non-ambiguous, while someone would perceive the greatest degree of ambiguity if valued at 4. The scale of the variable that denotes the perception of their relationship with their loved one runs from 2 to 10, where 2 represents the worst possible relationship, and 10 the best. This value is summed up after two questions. The variable that captures whether one has encountered a situation where their loved one is terminally ill, or recently passed away after being terminally ill, is denoted as follow: if either is the case, they are valued 1, and 0 otherwise. The variable age is scaled from 1 to 5, with 1 being under 20, 2 being 20-29, 3 being 30-39, 4 being 40-49 and 5 being above 50. If someone is male, this is denoted as 0, while someone who is female is denoted as 1.

Even though the explanation on how one should proceed in the survey was thought to be sufficient, some financial or statistical background was expected from the respondents to successfully complete the elicitation method. Examining the data that is received from the people willing to fill out the survey, 3 observations needed to be dropped. They violated stochastic dominance, meaning they preferred the AEX option over the given probability option for a higher probability, while they preferred the given probability option when provided a lower probability. After the drop, 33 observations are left that can be used in the analysis. From this sample, 3 people answered at least 1 of the 6 choice bets with a matching probability of 1, meaning that they preferred the ambiguous option over the given probability option for all probability expect certainty. Furthermore, there are 3 cases where maximal a-insensitivity is observed, while there is one case where a neutral stance towards ambiguity is observed. On the next page, Table 3 shows descriptive statistics of how each individual has perceived the context of discussing ACP to be, while Table 2 below shows the descriptive statistics of the indices.

Table 2. Descriptive statistics of the indices (N=33)

| Variable | Mean | Minimum | Maximum | $-1 \leq a < 0$ | $a = 0$ | $0 < a \leq 1$ |
|---|---|---|---|---|---|---|
| A-insensitivity | 0.437 | -0.63 | 1 | N = 5 | N = 0 | N = 28 |
| Ambiguity aversion | -0.155 | -0.833 | 0.483 | N = 24 | N = 1 | N = 8 |

Table 3. Descriptive statistics of surveyed variables (N=33)

| Variable | N | Frequency (%) |
|---|---|---|
| Willingness to discuss ACP | | |
| 1 (Definitely not willing) | 0 | |
| 2 (Probably not willing) | 1 | 3.03% |
| 3 (Might or might not be willing) | 1 | 3.03% |
| 4 (Probably willing) | 18 | 54.55% |
| 5 (Definitely willing) | 13 | 39.39% |
| Risk (how risky someone perceives discussing ACP to be) | | |
| 3 (Perceived as the lowest risk as possible) | 12 | 36.36% |
| 4 | 6 | 18.18% |
| 5 | 10 | 30.30% |
| 6 | 5 | 15.15% |
| 7 | 0 | |
| 8 | 0 | |
| 9 (Perceived as the highest risk as possible) | 0 | |
| Ambiguity (How ambiguous someone perceives discussing ACP to be) | | |
| 1 (No perceived ambiguity) | 17 | 51.52% |
| 2 (Some perceived ambiguity) | 11 | 33.33% |
| 3 (A lot of perceived ambiguity) | 5 | 15.15% |
| 4 (Perceived it as completely ambiguous) | 0 | |
| Relationship (Perceived closeness with loved one) | | |
| 2 (Most distant) | 0 | |
| 3 | 0 | |
| 4 | 1 | 3.03% |
| 5 | 1 | 3.03% |
| 6 | 4 | 12.12% |
| 7 | 4 | 12.12% |
| 8 | 15 | 45.45% |
| 9 | 6 | 15.15% |
| 10 (Closest) | 3 | 9.09% |
| Terminal illness (Loved ones who are or have been terminally ill) | | |
| 1 (Loved ones who are terminally ill or passed away after being) | 14 | 42.42% |
| 0 (No loved ones who are terminally ill nor are passed away after) | 19 | 57.58% |
| Age | | |
| 1 (under 20) | 2 | 6.06% |
| 2 (20-29) | 25 | 75.76% |
| 3 (30-39) | 6 | 18.18% |
| Gender | | |
| 1 (Female) | 16 | 48.48% |
| 0 (Male) | 17 | 51.52% |

To analyse the hypotheses in this study, interaction terms between variables are needed and transformations to the dataset are required. Omitting all people who perceived this context as non-ambiguous would have simplified this regression, however this is not possible within the data that is collected in this study, as half of the sample size would have been omitted. This would have reduced the number of specifications, as the variable ambiguity would not have to be considered anymore. Thus, to simplify the regression, it is opted to transform the risk perception and ambiguity variable. Rather

than analysing both variables as continuous, they are transformed to binary. Within the data that is collected in this research, this helps to differentiate between people who perceive the context as low and high risk, and between the ones perceiving the situation as ambiguous and non-ambiguous, which makes it easier to interpret the estimates of the regression. The trade-off however, can be found in the decreasing power of the model, as the estimates are less precise. To differentiate between low and high risk, the median is used. In the analysis, the people perceive the context as low risk are denoted as 0, while the ones as high risk are denoted as 1. As of whether the context is perceived as ambiguous, one of answers in the survey displayed an answer in which people could express that they do not perceive ambiguity. Thus, these observations present the sum of the non-ambiguous observations, while the others are seen as ambiguous. The observations understood as non-ambiguous are denoted as 0 in the analysis, while the ambiguous ones are denoted as 1. In tables 4 & 5 below is shown which observations are denoted as high and low risk, and which ones are understood as ambiguous and non-ambiguous.

Table 4. Sum of high and low risk observations

| Risk (how risky someone perceives discussing ACP to be) | N | |
|---|---|---|
| 3 (perceived as lowest risk as possible) | 12 | |
| 4 | 5 | |
| Sum of observations understood as low risk | | 17 |
| 5 | 10 | |
| 6 | 5 | |
| 7 | 0 | |
| 8 | 0 | |
| 9 (perceived as highest risk as possible) | 0 | |
| Sum of observations understood as high risk | | 15 |

Table 5. Sum of (non-)ambiguous observations

| Ambiguity (How ambiguous someone perceives discussing ACP to be) | N | |
|---|---|---|
| 1 (No perceived ambiguity) | 17 | |
| Sum of observations understood as non-ambiguous | | 17 |
| 2 (Some perceived ambiguity) | 11 | |
| 3 (A lot of perceived ambiguity) | 5 | |
| 4 (Perceived it as completely ambiguous) | 0 | |
| Sum of observations understood as ambiguous | | 16 |

As mentioned, interactions terms are needed to find evidence for the hypotheses. This study focuses on whether different levels of ambiguity attitudes are related to different outcomes in willingness to discuss ACP. Such ambiguity attitudes are understood within a certain context, in which probabilities and ambiguity exist. Through interaction terms, a better representation of the context is portrayed. In Table 6 below, the specifications of the regression are provided, grouped into variables that are used to provide evidence for the hypotheses, and control variables. The estimate $\beta_{10}$ controls for the relationship one has with their loved one, assuming that their closeness with their loved one influences their willingness to discuss ACP. The estimate $\beta_{11}$ controls for the fact whether one has encountered a situation in which

a loved one has passed away after being terminally ill, or a loved one who is terminally ill right now, assuming that thoughts on ACP have arisen after such events, which can impact their willingness to discuss ACP. Furthermore, the estimates $\beta_{12}$ & $\beta_{13}$ control for age and gender, respectively.

Table 6. Specifications of OLS regression for willingness to discuss ACP

| Variables of interest | Control variables | Constant and error term |
|---|---|---|
| $\beta_1 * (risk * ambiguity * a - insensitivity)_i$ | $\beta_{10} * relationship_i$ | $\beta_{14} * constant + \varepsilon_i$ |
| $\beta_2 * (risk * a - insensitivity)_i$ | $\beta_{11} * terminal\ illness_i$ | |
| $\beta_3 * (risk * ambiguity)_i$ | $\beta_{12} * age_i$ | |
| $\beta_4 * risk_i$ | $\beta_{13} * gender_i$ | |
| $\beta_5 * (ambiguity * a - insensitivity)_i$ | | |
| $\beta_6 * ambiguity_i$ | | |
| $\beta_7 * a - insensitivity_i$ | | |
| $\beta_8 * ambiguity\ aversion_i$ | | |
| $\beta_9 * (ambiguity * ambiguity\ aversion)_i$ | | |

## Outcome variable

In this analysis, the outcome variable $y_i$ is understood as the willingness to discuss ACP. This measure is obtained after subjects are presented a text in which the importance of ACP is discussed. The higher the value for this outcome variable is, the more willing they are to discuss ACP. This value runs from 1 to 5.

## Hypothesis 1

The first hypothesis concerns the people who perceive discussing ACP as an ambiguous high risk situation. It is stated that a-insensitive people are more likely to engage in discussions on ACP than their a-sensitive counterparts. This would lead to two types of people that are being compared, within the group of observations who are understood to perceive the context as highly risky and ambiguous. In Table 7 below the identification of the two types of subjects are defined.

Table 7. Identification of types of subjects for hypothesis 1

| | Risk | Ambiguity | A-insensitivity |
|---|---|---|---|
| Type A | High risk (=1) | Ambiguous (=1) | A-insensitive (=1) |
| Type B | High risk (=1) | Ambiguous (=1) | A-sensitive (=0) |
| Reference category | Low risk (=0) | Non-ambiguous (=0) | A-sensitive (=0) |

Looking at the variables of interest in Table 6, several estimates are of importance when trying to find evidence for this hypothesis. Since subjects who are understood as high risk are denoted as 1 through the risk variable, and the subjects who are understood to perceive this context as ambiguous are also

denoted as 1 through the variable ambiguity in this model, all the interaction terms and variables that include risk and ambiguity are relevant for this hypothesis. The difference in outcome between the two types is expected to come from their level of a-insensitivity. For Type A, the coefficients that measure a-insensitivity are relevant, where this is not the case for Type B, since Type B is considered to be a-sensitive in this comparison, meaning that their level of a-insensitivity is equal to 0, which would also be reflected in this model. In Table 9 below, the relevant coefficients per type of subject are shown.

Table 8. Relevant coefficients for types of subjects for H1

| Type of subject | Relevant coefficient |
|---|---|
| Type A | $\beta_1 + \beta_2 + \beta_3 + \beta_4 + \beta_5 + \beta_6 + \beta_7$ |
| Type B | $\beta_3 + \beta_4 + \beta_6$ |

By subtracting the estimates of Type A and Type B and using a post-estimation t-test on the sum of $\beta_1 + \beta_2 + \beta_5 + \beta_7$, evidence can be provided on whether the level of a-insensitivity can help explain the willingness to discuss ACP for people who perceive this context as an ambiguous high risk situation. This is expected to be positive, as the outcome variable is higher when people are more willing to discuss ACP.

## Hypothesis 2

The second hypothesis states that people who perceive this context to be an ambiguous low risk situation, are less likely to be willing to engage in conversations on ACP. Again, two types of subjects can be extracted from this hypothesis, which are provided in Table 9 below.

Table 9. Identification of types of subjects for hypothesis 2

| | Risk | Ambiguity | A-insensitivity |
|---|---|---|---|
| Type C | Low risk (=0) | Ambiguous (=1) | A-insensitive (=1) |
| Type D | Low risk (=0) | Ambiguous (=1) | A-sensitive (=0) |
| Reference category | Low risk (=0) | Non-ambiguous (=0) | A-sensitive (=0) |

Returning to Table 6, one can see that only three estimates are relevant for Type C, as low risk subjects are denoted as 0 through the risk variable. Therefore, all the interaction terms and variables that include the variable risk are not relevant for this hypothesis. Again, the difference in outcome is expected to be provided from their level of a-insensitivity. Thus, for Type C, the measures that include the variable a-insensitivity are relevant, while for Type D such measures are not needed, as Type D is expected to be a-sensitive. In Table 10 below, the relevant coefficients are provided.

Table 10. Relevant coefficients for types of subjects for H2

| Type of subject | Relevant coefficient |
|---|---|
| Type C | $\beta_5 + \beta_6 + \beta_7$ |
| Type D | $\beta_6$ |

Therefore, the sum of the coefficients $\beta_5 + \beta_7$ is needed to analyse when attempting to find evidence for the second hypothesis. Again, a post-estimation t-test is used on the sum of the coefficients to find evidence whether a-insensitive people are less willing to engage in ACP discussions, compared to a-sensitive people, for whom who perceive discussing ACP as an ambiguous low risk situation. This estimate is expected to be negative.

## Hypothesis 3

In the third hypothesis, it is stated that ambiguity averse people are less likely to be willing to discuss ACP than people who are less averse to ambiguity, for people who perceive this context as ambiguous. From this hypothesis, two subjects can be identified, which are provided in Table 11 below.

Table 11. Identification of types of subjects for hypothesis 3

| | Ambiguity | Ambiguity aversion |
|---|---|---|
| Type E | Ambiguous (=1) | Ambiguity averse (=1) |
| Type F | Ambiguous (=1) | Ambiguity neutral (=0) |
| Reference category | Non-ambiguous (=0) | Ambiguity neutral (=0) |

Again, for Type E three estimates are of interest, while for Type F only one estimate is of interest. Since Type F is considered to be ambiguity neutral, meaning that their level of ambiguity aversion is equal to 0, the measures that include ambiguity aversion are not relevant for this type of subject. In Table 12 below, the coefficients of interest for both types are shown.

Table 12. Relevant coefficients for types of subjects for H3

| Type of subject | Relevant coefficient |
|---|---|
| Type E | $\beta_6 + \beta_8 + \beta_9$ |
| Type F | $\beta_6$ |

By subtracting $\beta_6$ for both types of subjects, a post-estimation t-test on the sum of $\beta_8 + \beta_9$ is used in an attempt to find evidence for the third hypothesis. From the hypothesis, it follows that the estimate $\beta_8 + \beta_9$ is expected to be negative.

# Results

In Table 13, the specifications of the OLS regression are regressed against the outcome variable willingness to discuss ACP for two models.

Table 13. OLS regression for willingness to discuss ACP with two models

| Variable (coefficient) | (1) | (2) |
|---|---|---|
| Risk * ambiguity * a-insensitivity ($\beta_1$) | 1.069 (1.240) | 1.444 (1.131) |
| Risk * a-insensitivity ($\beta_2$) | -1.396 (0.876) | -1.574** (0.724) |
| Risk * ambiguity ($\beta_3$) | -0.641 (0.645) | -0.110 (0.614) |
| Risk ($\beta_4$) | 0.237 (0.587) | 0.252 (0.522) |
| Ambiguity * a-insensitivity ($\beta_5$) | -1.696* (0.957) | -1.830* (0.978) |
| Ambiguity ($\beta_6$) | 0.587 (0.651) | 0.614 (0.589) |
| A-insensitivity ($\beta_7$) | 1.206 (0.721) | 1.372** (0.614) |
| Ambiguity aversion ($\beta_8$) | -0.498 (0.435) | -0.489 (0.436) |
| Ambiguity * ambiguity aversion ($\beta_9$) | 1.041 (0.815) | 1.339 (0.912) |
| Relationship ($\beta_{10}$) | 0.143 (0.085) | 0.130 (0.087) |
| Terminal illness ($\beta_{11}$) | -0.357 (0.278) | -0.471 (0.291) |
| Age ($\beta_{12}$) | 0.340 (0.270) | |
| Gender ($\beta_{13}$) | 0.092 (0.238) | |
| Constant ($\beta_{14}$) | 2.118* (1.083) | 2.984*** (0.884) |
| N | 33 | 33 |
| Adjusted $R^2$ | 0.5080 | 0.4617 |

Note. Robust standard errors in parentheses for the last two columns. * p < 0.1, ** p < 0.05, *** p < 0.01

Because of the small sample size, it is opted to have two models. In an attempt to increase the low degrees of freedom, age and gender are omitted from the second model. The results of the first model only shows one statistically significant value. For this model, it is assumed that age and gender are not necessarily meaningful controls in reducing noise within the data sample that is collected. As shown in the second model, the omission of those controls lets some of the variables of interest to be statistically significant. In the first model, only $\beta_5$ and the constant variable are statistically significant, both at p < 0.1. In the second model, multiple variables are statistically significant. Where the constant variable is statistically significant at p < 0.01, $\beta_2$ & $\beta_7$ are statistically significant at p < 0.05, while $\beta_5$ is statistically significant at p < 0.1.

## Hypothesis 1

As mentioned in the section above, the sum of multiple coefficients has to be analysed in order to provide evidence for the first hypothesis. The first hypothesis states that, for those who perceive discussing ACP as an ambiguous high risk situation, a-insensitive people are more willing to engage in discussing ACP than a-sensitive people. Therefore, it is expected that the sum of $\beta_1 + \beta_2 + \beta_5 + \beta_7$ is

positive. In this model, the sum of coefficients needed to provide evidence for the first hypothesis is corresponding with the variables that are presented in Table 14 below.

Table 14. Relevant measures in the analysis of H1

| Variable (coefficient) | (1) | (2) |
|---|---|---|
| Risk * ambiguity * a-insensitivity ($\beta_1$) | 1.069 (1.240) | 1.444 (1.131) |
| Risk * a-insensitivity ($\beta_2$) | -1.396 (0.876) | -1.574** (0.724) |
| Ambiguity * a-insensitivity ($\beta_5$) | -1.696* (0.957) | -1.830* (0.978) |
| A-insensitivity ($\beta_7$) | 1.206 (0.721) | 1.372** (0.614) |

Note. Robust standard errors in parentheses for the last two columns. * p < 0.1, ** p < 0.05, *** p < 0.01

Table 15. Sum of coefficients to provide evidence for H1

| Sum of coefficients | (1) | (2) |
|---|---|---|
| $\beta_1 + \beta_2 + \beta_5 + \beta_7$ | -0.817 (0.777) | -0.589 (0.706) |

Note. Robust standard errors in parentheses. * p < 0.1, ** p < 0.05, *** p < 0.01

Even though three of the four variables are statistically significant on their own in the second model, Table 15 shows that the sum of these coefficients are statistically insignificant in both models, meaning no evidence can be found for the first hypothesis. Furthermore, the sign of the estimate could have revealed that no evidence could not had been provided, since the expectation was a positive sign and not a negative sign.

## Hypothesis 2

Similar to the first hypothesis, the sum of several coefficients is needed to find evidence for the second hypothesis. However, the sum of $\beta_5 + \beta_7$ is expected to be negative, since the second hypothesis stated that a-insensitive people are less willing to engage in ACP discussions than a-sensitive people when discussing ACP is perceived as an ambiguous low risk situation. As provided in Table 16, this would translate to the sum of the following variables being negative:

Table 16. Relevant measures in the analysis of H2

| Variable (coefficient) | (1) | (2) |
|---|---|---|
| Ambiguity * a-insensitivity ($\beta_5$) | -1.696* (0.957) | -1.830* (0.978) |
| A-insensitivity ($\beta_7$) | 1.206 (0.721) | 1.372** (0.614) |

Note. Robust standard errors in parentheses for the last two columns. * p < 0.1, ** p < 0.05, *** p < 0.01

Table 17. Sum of coefficients to provide evidence for H2

| Sum of coefficients | (1) | (2) |
|---|---|---|
| $\beta_5 + \beta_7$ | -0.490 (0.606) | -0.458 (0.694) |

Note. Robust standard errors in parentheses. * p < 0.1, ** p < 0.05, *** p < 0.01

Where both variables are statistically significant in the second model, this is unfortunately not the case when the sum of coefficients is analysed, as Table 17 shows. This means that no evidence can be found for the second hypothesis.

### Hypothesis 3

To provide evidence for the third hypothesis, one would need to show that the sum of the measures $\beta_8 + \beta_9$ is a negative value, as it states that people who are more ambiguity averse are less willing to engage in ACP discussions than people who are less ambiguity averse, when discussing ACP is perceived as an ambiguous situation. In Table 18 below, the variables that are needed to be analysed together are shown.

Table 18. Relevant measures in the analysis of H3

| Variable (coefficient) | (1) | (2) |
|---|---|---|
| Ambiguity aversion ($\beta_8$) | 0.480 (0.435) | 0.489 (0.436) |
| Ambiguity * ambiguity aversion ($\beta_9$) | -1.041 (0.815) | -1.339 (0.912) |

Note. Robust standard errors in parentheses for the last two columns. * p < 0.1, ** p < 0.05, *** p < 0.01

Table 19. Sum of coefficients to provide evidence for H3

| Sum of coefficients | (1) | (2) |
|---|---|---|
| $\beta_8 + \beta_9$ | 0.543 (0.731) | 0.849 (0.816) |

Note. Robust standard errors in parentheses. * p < 0.1, ** p < 0.05, *** p < 0.01

As Table 19 shows, the sum of $\beta_8 + \beta_9$ did not provide statistically significant values in both models, meaning that no evidence can be found for the third hypothesis. Like the estimates for the first hypothesis, the sign of the estimates in both models are different from the ones that were expected. This could had indicated that evidence could not have been found. Within the data that is collected in this study, the three hypotheses proposed are rejected.

## Robustness check

The focus of the study is on the people who perceive ambiguity in this context. It could be argued that people who have a better relationship with their loved one – in their perception – are experiencing less ambiguity than the people who perceive their relationship to be worse. Omitting the observations which state they have a good relationship with their loved one could thus provide a robustness check. For this to be true, one would need to check whether a correlation exists between ambiguity and perceived relationship. This correlation is checked both for the continuous and binary form of ambiguity. In this sample, it appears that roughly 25% of the observations perceive their relationship to be good, meaning

their relationship is valued at either 9 or 10, with 10 being denoted the best possible relationship and 2 the worst possible. This boils down to 8 observations being omitted from the regression.

Table 20. Correlation ambiguity and perceived relationship (N=33)

| | Ambiguity (continuous) | Ambiguity (discrete) |
|---|---|---|
| Relationship | -0.165* (0.087) | -0.119** (0.048) |

Note. Robust standard errors in parentheses * p < 0.1, ** p < 0.05, *** p < 0.01

The correlation for both the continuous and binary version of ambiguity in the sample that includes all observations (N=33) is statistically significant, for p < 0.1 and p < 0.05 respectively. This would mean that the closer someone is with their loved one, the less likely they would perceive ambiguity in this context. In Table 21, the robustness check is performed.

Table 21. Robustness check

| Variable (coefficient) | (1) | (2) |
|---|---|---|
| Risk * ambiguity * a-insensitivity ($\beta_1$) | 1.678 (1.484) | 1.714 (1.174) |
| Risk * a-insensitivity ($\beta_2$) | -1.694 (1.241) | -1.528* (0.802) |
| Risk * ambiguity ($\beta_3$) | -0.407 (0.969) | -0.184 (0.720) |
| Risk ($\beta_4$) | 0.436 (0.921) | 0.192 (0.630) |
| Ambiguity * a-insensitivity ($\beta_5$) | -2.463* (1.171) | -2.192* (1.058) |
| Ambiguity ($\beta_6$) | 0.898 (1.058) | 0.706 (0.827) |
| A-insensitivity ($\beta_7$) | 1.812 (1.122) | 1.616* (0.800) |
| Ambiguity aversion ($\beta_8$) | 0.244 (0.289) | 0.173 (0.304) |
| Ambiguity * ambiguity aversion ($\beta_9$) | 0.251 (0.801) | 0.774 (0.941) |
| Relationship ($\beta_{10}$) | 0.067 (0.120) | 0.059 (0.103) |
| Terminal illness ($\beta_{11}$) | -0.457 (0.382) | -0.651 (0.428) |
| Age ($\beta_{12}$) | 0.428 (0.322) | |
| Gender ($\beta_{13}$) | 0.168 (0.388) | |
| Constant ($\beta_{14}$) | 2.202 (1.459) | 3.513*** (1.068) |
| N | 25 | 25 |
| Adjusted $R^2$ | 0.68291 | 0.4779 |

Note. Robust standard errors in parentheses for the last two columns. * p < 0.1, ** p < 0.05, *** p < 0.01

Like the main analysis in Table 13, the first model provided statistically significant values for $\beta_5$ and the constant variable, while the second model showed statistically significant values for $\beta_2$, $\beta_5$, $\beta_7$ and the constant variable. Even though 8 observations were omitted, the same variables showed statistical significance, albeit it at different p-values. For this study however, it is more interesting to look at whether the hypotheses have changed in their statistical significance. Table 22 below provides the values of the sum of coefficients that are needed to be analysed for the three hypotheses in both models.

Table 22. Sum of coefficients to provide evidence for the hypotheses

| | Sum of coefficients | (1) | (2) |
|---|---|---|---|
| Hypothesis 1 | $\beta_1 + \beta_2 + \beta_5 + \beta_7$ | -0.666 (0.739) | -0.390 (0.636) |
| Hypothesis 2 | $\beta_5 + \beta_7$ | -0.650 (0.624) | -0.576 (0.799) |
| Hypothesis 3 | $\beta_8 + \beta_9$ | 0.495 (0.843) | 0.947 (0.974) |

Note. Robust standard errors in parentheses. * p < 0.1, ** p < 0.05, *** p < 0.01

Unfortunately, no evidence is found for either hypotheses in the robustness check. Had there been evidence found for one of the hypotheses in the main analysis, this scenario would have meant that the robustness check had not succeeded, meaning that it could be suggested that ambiguity does not influence this context.

# Discussion

In this paper, an attempt is made to understand whether ambiguity attitudes can explain the willingness to initiate a discussion on ACP. A significant minority of the elderly have not had any conversations on EoL care or ACP, and this can negatively influence their own well-being. Furthermore, discussing such matters can help smooth out the process of dying, which can improve outcome for all parties involved. Many people are avoidant of the topic because of the nature of the matter that is discussed or due to stress from their daily life, while others have simply not put thought into it. Theoretical models of behavioural change have been proposed to increase the number of AD. It seems that the first two stages are reserved for creating a space in which awareness can be spread, or in which the unwilling are giving room to reflect their daily troubles, which can lead to an interest in ACP. Even though personnel of health institutions can be trained to such an extent that they can effectively help and guide patients towards an interest in ACP, this has turned out to be quite resourceful and demanding. Moreover, the training programmes are not easily generalised, due to cultural diversity. This has led to idea that close friends or family members could be of help in the process of increasing AD. They themselves benefit from it in the sense that a deeper relationship can be established, or that the grieving can be eased. However, one could also experience setbacks in their relationship, as discussing an abstract concept as death can be displeasing and difficult. Considering the risk that is associated with discussing ACP, using measures as a-insensitivity and ambiguity aversion to grasp ambiguity attitudes, an attempt is made to understand whether ambiguity attitudes can explain the willingness to discuss ACP.

The results did not provide any evidence for the hypotheses proposed in this study. It could be the case that the power of the model was weak, since the sample size was quite small. A larger sample size in behavioural measures is always useful, which increases the degrees of freedom, resulting in a greater variability of the parameters. This could lead to more accurate estimates, through which statistical significant values may be found to provide evidence for the proposed hypotheses. Had the results provided evidence for the hypotheses, they would have been limited in their meaning. It could have

been the case that another variable is related to their level of a-insensitivity or ambiguity aversion and their willingness to discuss ACP. Omitted variable bias seems reasonable and thus cannot be ruled out in this study. Furthermore, their a-insensitivity or ambiguity aversion level could be merely a snapshot of how they perceive the choice bets to be in that moment. If that were the case, it would follow that the correlations found in the study are not robust and would not be found for the same sample group but surveyed at another time. In extension, the way how they view ACP can change over time, not only because they acquired new knowledge, but also due to a change in their emotional state. The influence of one's emotions on a particular touchy subject as is presented in this study, while having to deal with uncertain probabilities and events that have yet to happen, can be significant. Therefore, the data that is collected in the study can be prone to an emotional bias, which is difficult to control for. As mentioned, the oversimplification of the model, where subjects can only perceive discussing ACP as low/high risk and ambiguous/non-ambiguous, seems to be off the context that is attempted to be portrayed. Through such categorisation it is expected that the power of the model would decrease.

Generally, it was found that people preferred the lower end of the risk perception level. If one were to understand this context in terms of the prospect theory, it could be assumed that it can be analysed in the loss domain. In this context, the higher the probability, the higher the chance that one expects a negative outcome. If losses are met with more risk-seeking behaviour (Angner, 2016), this could be reflected in their perception of the context as low risk, which can explain that the median of the risk perception variable is on the lower end of the spectrum. In this study, a proxy for risk perception is created through two abstract questions on death and one question on fear of damaging their relationship with their loved one after discussing ACP. They could be difficult to grasp, or perceived as quite extreme, which might also explain why people stuck to the lower end of the spectrum of risk. To create a better understanding of risk perception of the subjects, one could opt to survey people on how they perceive risk for different outcomes. Asking whether they think whether discussing ACP would lead to an awkward dinner, or could spoil the fun in future activities, or how other outcomes can be negatively influenced by the introduction of ACP, could motivate the subject to explore the impact of discussing ACP better, which might lead to a greater differentiation in perceived level of risk between subjects. If survey questions on risk perception are assigned different weights and a broader range of answers is provided, a more balanced perception of risk could be obtained.

Similarly, the degree of ambiguity is not as easily defined as is proposed in this paper. It is hard to capture whether one feels ambiguous, and even more difficult to understand what the degree of ambiguity is they perceive. Interestingly, the sample size was confident in their risk perception on discussing ACP. More than half of the sample stated that they do not perceive any ambiguity whatsoever. Comparing this sample to the sample that Zenasni et al. (2008) collected, in which they found a positive correlation between creativity and tolerance of ambiguity, no subject was measured as

completely tolerant towards ambiguity. It could be the case that the method they used to measure ambiguity in their context is more profound, compared to the single question that was asked on ambiguity in this study. Assuming that ambiguity is eminently present in every situation, further research could use a measure such as tolerance of ambiguity as proxy, rather than a subjective answer on how certain they feel that discussing ACP would damage their relationship with their loved one. Furthermore, the questions that provide a proxy for the perceived closeness with their loved one is concerned around whether they generally feel understood by them and how meaningful they judge the conversations are with them. If the questions that denote the perceived relationship were laid next to the question that provides a proxy for ambiguity, it could be argued that some resemblance can be seen. If they were completely similar in outcome, it would mean that one of the variables were to be omitted in the analysis. Fortunately, this was not the case. However, there is still a possibility that the effect of ambiguity is less apparent when both variables are used in the regression. Table A.1 shows a regression where the perceived relationship variable is omitted. Again, no evidence is found for the hypotheses.

Due to the nature of a survey, which is based on subjectivity, it could be the case that subjects misinterpret their perception of discussing ACP. In other words, isolating the effect for risk and ambiguity or their quality of relationship is difficult, as the measures are obtained introspectively. For example, it could be that someone who actually perceives the situation as highly ambiguous but as low risk, misinterprets their own perception, and instead of communicating it in such a manner, they might be understood as someone who perceives discussing ACP to be a non-ambiguous high risk situation. Since subjects are grouped into high/low risk and ambiguous/non-ambiguous categories, this issue has rather been soothed, as over- or undervaluation of these variables might be masked. For example, when someone does not know to what extent they perceive the situation to be ambiguous, understanding subjects in the model as ambiguous and non-ambiguous can help eliminate misperceptions. When one opts to analyse these variables in continuous forms, where degrees of ambiguity and risk perception are present, not knowing whether the estimates of those variables are representing the context accurately can prove to be a limitation.

What could make this study more interesting, would be an a priori research on the sample size. For example, if the relationship between a child and parent is investigated in this context, it will be crucial information to know whether the parent has actually thought of ACP. In this research, it is assumed that the child does not know whether their parent has thought about ACP or not. While this assumption is not completely out of reach, it could be argued that the child, to a certain extent, is able to extract - from personality, behaviour and conversations that are held - whether their parent has thought about it or not. This is met with a lot uncertainty, making it hard to control for. However, if one were to interview the parents simultaneously when the children are surveyed, one would know what the exact situation is. The observations where the parent has had thought about ACP are then to be dropped, as it is arguably

more important to research the situations where the parent has not thought about ACP. Further research could also focus on specific target groups. While the sample size in this paper has been fairly centred around students or people who just left college for the workforce, their cultural background was not considered. Most research that has been conducted in this field has focused on specific parts of the population. For example, Bernato et al. (2009) explored whether racial and ethnic differences can explain for differences in end-of-life treatment, while Eleazer et al. (1996) showed that religion has been a common barrier to complete AD. This could also be implemented when researching the mechanism proposed in this paper, as the community in which one grew up in can have an impact on both the ambiguity attitudes and risk perception on the one hand, and willingness to discuss ACP on the other.

That being said, the main limitation of the method used in this research concerns the fact that the indices are obtained in the financial domain, and more specifically, in the domain of changes in stock value. While it might be possible to draw some general conclusions using the indices proposed by Baillon et al. (2018), in the sense that some correlations can be found in the way they act in the financial domain and the way they behave in other situations, none of this can be found in the literature when this paper is written. This makes it difficult to justify the reliability of the method in the domain of interest, as it is unknown how ambiguity attitudes relate to contexts such as discussing ACP. When measuring ambiguity attitudes in the financial domain, their method allowed them to control for risk behaviour, meaning that the indices could be obtained irrespective of subjects being risk averse or risk-seeking. This was possible because they could use objective probabilities, since the choice sets were given. With the use of matching probabilities, where an ambiguous bet is placed against a given probability bet, they allowed ambiguity to factor in, which led to a more valid measurement of ambiguity attitudes. Incorporating real events when measuring ambiguity attitudes, rather than measuring ambiguity attitudes using artificial events and researching the correlations with risk behaviour, where ambiguity neutrality is assumed, increases validity. Such method can be adapted to different situations, like Li et al. (2018) did to research how ambiguity attitudes affect the outcome of trust games. Such games are inherently ambiguous, since the outcome of both players depends on the reciprocation of trust. Through a modification, they were able to measure ambiguity attitudes, while controlling for risk beliefs. Because they used trust game events rather than artificial events, such as the Ellsberg urns, which is traditionally used to measure ambiguity aversion, they increased validity. In this research, it was unfeasible to measure ambiguity attitudes within the domain of interest. Risk beliefs had to be obtained introspectively, rather than observing behaviour towards given events. While ambiguity can be reasonably assumed, it is not inherently present. Through these caveats, the validity of the method in this context is problematic. While surveying risk and ambiguity perception can be readily improved, other methods need to be developed and deployed to understand ambiguity attitudes better in behavioural domains where is dealt with subjective probabilities.

# Appendix

Table A1. OLS regression having omitted perceived relationship

| Variable (coefficient) | (1) | (2) |
|---|---|---|
| Risk * ambiguity * a-insensitivity ($\beta_1$) | 0.853 (1.287) | 1.247 (1.147) |
| Risk * a-insensitivity ($\beta_2$) | -1.047 (0.908) | -1.283 (0.761) |
| Risk * ambiguity ($\beta_3$) | -0.109 (0.639) | -0.140 (0.596) |
| Risk ($\beta_4$) | 0.009 (0.561) | 0.040 (0.498) |
| Ambiguity * a-insensitivity ($\beta_5$) | -1.350 (1.030) | -1.512 (1.033) |
| Ambiguity ($\beta_6$) | 0.330 (0.649) | 0.382 (0.595) |
| A-insensitivity ($\beta_7$) | 0.981 (0.778) | 1.168 (0.685) |
| Ambiguity aversion ($\beta_8$) | -0.468 (0.507) | -0.471 (0.535) |
| Ambiguity * ambiguity aversion ($\beta_9$) | 0.973 (0.873) | 1.279 (0.971) |
| Terminal illness ($\beta_{11}$) | -0.234 (0.298) | -0.361 (0.306) |
| Age ($\beta_{12}$) | 0.302 (0.296) | |
| Gender ($\beta_{13}$) | 0.122 (0.236) | |
| Constant ($\beta_{14}$) | 3.475*** (0.674) | 4.162*** (0.436) |
| N | 33 | 33 |
| Adjusted $R^2$ | 0.4564 | 0.4182 |

Note. Robust standard errors in parentheses for the last two columns * p < 0.1, ** p < 0.05, *** p < 0.01

Table A2. Sum of coefficients to analyse the hypotheses

| | Sum of coefficients | (1) | (2) |
|---|---|---|---|
| Hypothesis 1 | $\beta_1 + \beta_2 + \beta_5 + \beta_7$ | -0.563 (0.711) | -0.380 (0.624) |
| Hypothesis 2 | $\beta_5 + \beta_7$ | -0.369 (0.665) | -0.344 (0.709) |
| Hypothesis 3 | $\beta_8 + \beta_9$ | 0.505 (0.739) | 0.808 (0.823) |

Note. Robust standard errors in parentheses. * p < 0.1, ** p < 0.05, *** p < 0.01

Table A3. Survey with diagrams and information blocks

Introduction of survey:

The AEX index is comprised of the value of the top 25 companies which are operating on that stock market. This is a place where people or institutions can buy and sell the stocks of those companies. The price of the stocks at which they are bought and sold are influenced by many factors. These include financial reports, mergers, a new product launch, or hiring a new CEO. Essentially, due to the multitude of factors at play, it is almost impossible to predict whether the price of a company's stock increases or decreases. In other words, betting whether the AEX index increases or decreases within 24 hours is an ambiguous option, meaning that you do not know what the exact chances are whether it increases or decreases. In every choice bet, you will be asked whether you prefer this AEX option or an option in which you do know the probability level. To make it easier, the amount you can win is the same in both options.

In this survey, there are six choice bets. This means that there are six different AEX options. They are similar, the only difference that each AEX option represents a different percentage change. For 20

different probability levels you will be asked whether you prefer the given probability option (option 1) or the AEX option (option 2). In other words, every choice bet can be seen as 20 sub-choice bets. This might sound a lot, knowing that you have to do 6 choice bets. However, once doing the exercises, you will realise that it is not as exhausting as it sounds. As seen in the example below, there are 20 levels of p. For each level of p, you should ask yourself whether you prefer the given probability option (option 1) or the AEX index option (option 2). For p = 0% you would naturally choose the AEX option, as some chance to win €20 is better than no chance of winning it. For p = 100% you would choose the given probability option, as you would be certain to win the bet.

If you prefer the given probability option (option 1) with p = 75%, you would also choose this option if p = 85%. When given a higher probability for the same bet, it is expected that you would still choose option 1. Similarly, if you prefer the AEX option (option 2) over the given probability option (option 1) when p = 30%, you would also prefer option 2 over option 1 when p = 15%.

Figure A1. Choice bet #2

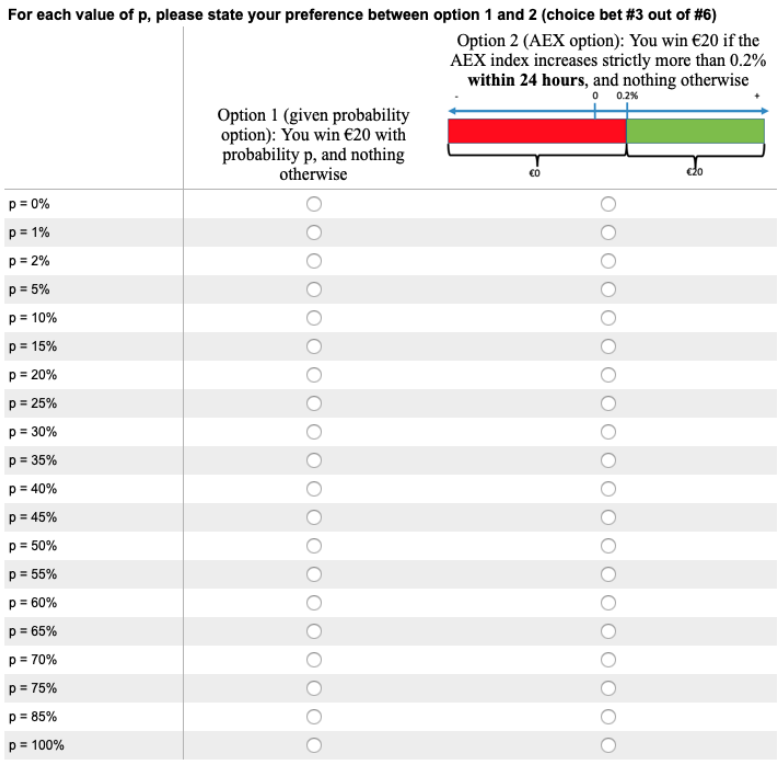


Figure A2. Choice bet #3

**For each value of p, please state your preference between option 1 and 2 (choice bet #3 out of #6)**

| | Option 1 (given probability option): You win €20 with probability p, and nothing otherwise | Option 2 (AEX option): You win €20 if the AEX index increases strictly more than 0.2% **within 24 hours**, and nothing otherwise   |
|---|---|---|
| p = 0% | ○ | ○ |
| p = 1% | ○ | ○ |
| p = 2% | ○ | ○ |
| p = 5% | ○ | ○ |
| p = 10% | ○ | ○ |
| p = 15% | ○ | ○ |
| p = 20% | ○ | ○ |
| p = 25% | ○ | ○ |
| p = 30% | ○ | ○ |
| p = 35% | ○ | ○ |
| p = 40% | ○ | ○ |
| p = 45% | ○ | ○ |
| p = 50% | ○ | ○ |
| p = 55% | ○ | ○ |
| p = 60% | ○ | ○ |
| p = 65% | ○ | ○ |
| p = 70% | ○ | ○ |
| p = 75% | ○ | ○ |
| p = 85% | ○ | ○ |
| p = 100% | ○ | ○ |

Figure A3. Choice bet #4

**For each value of p, please state your preference between option 1 and 2 (choice bet #4 out of #6)**

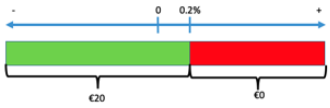
| | Option 1 (given probability option): You win €20 with probability p, and nothing otherwise | Option 2 (AEX option): You win €20 if the AEX index either decreases or increases by less than 0.2% **within 24 hours**, and nothing otherwise   |
|---|---|---|
| p = 0% | ○ | ○ |
| p = 20% | ○ | ○ |
| p = 35% | ○ | ○ |
| p = 40% | ○ | ○ |
| p = 45% | ○ | ○ |
| p = 50% | ○ | ○ |
| p = 55% | ○ | ○ |
| p = 60% | ○ | ○ |
| p = 65% | ○ | ○ |
| p = 70% | ○ | ○ |
| p = 75% | ○ | ○ |
| p = 80% | ○ | ○ |
| p = 85% | ○ | ○ |
| p = 90% | ○ | ○ |
| p = 93% | ○ | ○ |
| p = 95% | ○ | ○ |
| p = 97% | ○ | ○ |
| p = 98% | ○ | ○ |
| p = 99% | ○ | ○ |
| p = 100% | ○ | ○ |

Figure A4. Choice bet #5

**For each value of p, please state your preference between option 1 and 2 (choice bet #5 out of #6)**

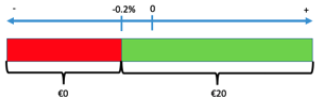
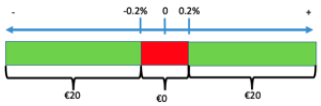
| | Option 1 (given probability option): You win €20 with probability p, and nothing otherwise | Option 2 (AEX option): You win €20 if the AEX index either decreases by less than 0.2% or increases **within 24 hours**, and nothing otherwise.   |
|---|---|---|
| p = 0% | ○ | ○ |
| p = 20% | ○ | ○ |
| p = 35% | ○ | ○ |
| p = 40% | ○ | ○ |
| p = 45% | ○ | ○ |
| p = 50% | ○ | ○ |
| p = 55% | ○ | ○ |
| p = 60% | ○ | ○ |
| p = 65% | ○ | ○ |
| p = 70% | ○ | ○ |
| p = 75% | ○ | ○ |
| p = 80% | ○ | ○ |
| p = 85% | ○ | ○ |
| p = 90% | ○ | ○ |
| p = 93% | ○ | ○ |
| p = 95% | ○ | ○ |
| p = 97% | ○ | ○ |
| p = 98% | ○ | ○ |
| p = 99% | ○ | ○ |
| p = 100% | ○ | ○ |

Figure A5. Choice bet #6

**For each value of p, please state your preference between option 1 and 2 (choice bet #6 out of #6)**

| | Option 1 (given probability option): You win €20 with probability p, and nothing otherwise | Option 2 (AEX option): You win €20 if the AEX index either decreases by strictly more than 0.2% or increases by strictly more than 0.2% **within 24 hours**, and nothing otherwise.   |
|---|---|---|
| p = 0% | ○ | ○ |
| p = 20% | ○ | ○ |
| p = 35% | ○ | ○ |
| p = 40% | ○ | ○ |
| p = 45% | ○ | ○ |
| p = 50% | ○ | ○ |
| p = 55% | ○ | ○ |
| p = 60% | ○ | ○ |
| p = 65% | ○ | ○ |
| p = 70% | ○ | ○ |
| p = 75% | ○ | ○ |
| p = 80% | ○ | ○ |
| p = 85% | ○ | ○ |
| p = 90% | ○ | ○ |
| p = 93% | ○ | ○ |
| p = 95% | ○ | ○ |
| p = 97% | ○ | ○ |
| p = 98% | ○ | ○ |
| p = 99% | ○ | ○ |
| p = 100% | ○ | ○ |

Survey questions (including information blocks):

| | |
|---|---|
| For the purpose of this survey, use one of your family members as reference for the next set of questions. This can be either one of your parents, grandparents, or an elder uncle or aunt. It is important for this survey that they are significantly older than you are. | |
| What is the relationship you have with the person in mind? | |
| To illustrate the importance of advance care planning, please read the following part.<br><br>Your loved one has been diagnosed with a terminal illness which requires quick decision-making. This person is unable to weigh the consequences of the several treatment options, because they feel overwhelmed by the sudden news. Research has shown that discussing how one would like to spend his or her old day is beneficial to someone who is facing the prospects of terminal illness. Having thought about advance care planning increases patient outcome, which is beneficial for everyone involved in the process of dying.<br><br>However, a significant number of people are unwilling to discuss this matter, due to stress from their daily problems, fear of death, or believing that their family should decide what the course of action is when the time has come when treatment options are to be weighted.<br><br>Advance care planning can be interpreted broader than just weighing the treatment options. It can create an environment in which relationships can find more depth. Understanding how your loved one deals with death, can help you through the grieving. On the other hand, it can also be detrimental to your relationship with this person. Death being a highly abstract concept, it can be difficult to find any middle ground when you want to discuss this matter. This can lead to uncomfortable situations, which might damage your relationship with this person. | |

| | |
|---|---|
| After reading the part above, are you willing to have a discussion on advance care planning with your loved one? | Definitely yes, probably yes, might or might not, probably not, definitely not |
| Do you believe your loved one and you hold the same ideas on the afterlife? | Yes, we are same-minded; the narratives we hold are not the same, but are similar in many ways; no, we have completely different ideas on the afterlife |
| Do you think the way you feel about death is reciprocated by your loved one? | Yes, we feel similarly about death; not completely similar, but a middle ground can be found; no we do not feel similar at all on it |
| Do you think discussing advance care planning with your loved one could damage your relationship with them? | Yes, I fear it will damage our relationship; the conversation can go both ways, it will either be meaningful or it will damage our relationship; no I am confident that it will not change the relationship for the worse |
| How sure are you about the answer in the last question? | I am absolutely sure about my answer, I am confident about my answer, I have some doubts on it, I have absolutely no idea how it is going to play out |
| Generally speaking, do you feel you have meaningful conversations with them? | Extremely pleased, somewhat pleased, neither pleased nor displeased, somewhat displeased, extremely displeased |
| Generally speaking, how well do you feel understood by them? | Extremely good, somewhat good, neither good or bad, somewhat bad, extremely bad |
| What is your age? | Under 20, 20-29, 30-39, 40-49, above 50 |
| What is your gender? | Male, female |
| Has there recently been a loved one who passed away after being terminally ill, or is there a loved one who is terminally ill right now? | Yes, a loved one recently passed away; Yes, a loved one is terminally ill right now; no |

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