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Differences in Blame-Like and Forgiveness-Like Judgments between Young People, Healthy Older People, and Older People with Dementia

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Abstract

The objective of the present experimental study was to compare how young people, healthy older people, and older people with dementia cognitively integrated three factors (Intention, Consequence, and Apology) when making blame-like judgments (prosecution and revenge) and forgiveness-like judgments (resentment and reconciliation). Thirty-four young people (*Mage* = 22.12, *SD* = 3.44), 22 healthy older people (*Mage* = 71.82, *SD* = 8.69), and 18 older people with dementia (*Mage* = 75, *SD* = 10.06) participated in the study. The participants were confronted with 12 scenarios built by combining the three factors for each moral judgment. Analyses of variance with repeated measures were applied to the study data. Whatever the type of judgment, older people with dementia differed from young people and healthy older people about the number of factors considered. Young people and healthy older people used the three information cues (Intent, Consequence, and Apology) for the four judgment tasks (prosecution, revenge, reconciliation, and resentment). In comparison, older people with

dementia gave greater weight to Intention. In contrast to young and healthy older people, older people with dementia processed blame-like and forgiveness-like judgments similarly. The cognitive impairment prevented older people with dementia from differentiating moral judgments into two categories and reduced information integration when making moral judgments. These findings might be useful for clinical practice.

Keywords
Blame; forgiveness; judgment; dementia; information integration

1. Introduction

Dementia is one of the main causes of dependency and disability among older people [1]. It notably worsens a person's cognitive functions, such as moral judgment. A person judges another person's actions by considering outcomes and intentions. The relative importance given to these two variables might change as people age [2].

Studies of how older adults integrate intentions and outcomes into their moral judgments have shown that they tend to rely more on outcomes and less on intentions [2-5]. Margoni et al. showed that about moral judgments, older adults and younger adults differed in the extent to which they relied on intentions and outcomes in harm scenarios and in help scenarios [3]. Older adults relied less on intentions than younger adults did but only when judging harmful scenarios. An intent-to-outcome shift was found in harm scenarios but not in help scenarios. This shift has also been found in older adults who inferred negligence from negative outcomes [2] and in second-party social economic decisions [4, 5]. However, further research by Margoni et al. found that older and younger adults did not differ in their moral judgment [6]. The latter study did not replicate the previously described intent-to-outcome shift. Thus, an intent-to-outcome shift might not be found in all aging populations, and it is necessary to apply various theoretical frameworks to moral judgments [6].

Some researchers have applied information integration theory to studies of moral judgment [7]. This theoretical framework describes how individuals cognitively combine various information cues when deciding or elaborating a moral judgment [7]. Information integration theory has already been applied to studies of older people with dementia and healthy (i.e., non-demented) older people [8, 9]. Fontaine et al. compared the cognitive operation of moral judgment in healthy older adults vs. older people with Alzheimer's disease dementia [8]. They studied how the two groups of participants mentally integrated the intention and the consequence of the act in blame tasks. The main finding was that healthy older adults and older people with dementia differed in the cognitive mechanism for blame judgments.

To specify Fontaine et al.'s results [8], Decroix et al. compared young adults, healthy older adults and older people with dementia in two separate studies of the mechanisms of blame and forgiveness judgments [9]. In the first study, the researchers found that older adults with dementia differed from both young adults and healthy older adults in the way that they mentally integrated two information cues (the intention and the consequence) in a blame task and in a forgiveness task [9]. Although the older people with dementia took account of intent and consequence in blame judgments, they gave less weight to consequence: the more intentional the act, the more

blameworthy it was considered to be [9]. Conversely, older adults with dementia only considered the intention factor in forgiveness judgments. These results highlighted the impact of dementia on judgments of blame and forgiveness and confirmed that the cognitive processes involved in moral judgments are different in older people with dementia [8]. Furthermore, cue integration by older adults with dementia depends on the kind of moral judgment. In the second study, Decroix et al. compared the ability of older people with dementia to integrate more than two information cues when making a judgment [9]. The results showed that when scenarios contained three, four or five information cues, the older people with dementia considered no more than two. The intention was an invariant information cue (i.e., it was considered in all types of judgment) and was prioritized in each type of judgment by older adults with dementia. Decroix et al. stated that other types of moral judgment should be studied [9, 10].

Mullet et al. presented a two-dimensional ("prosecutorial perspective vs. theological perspective") moral model based on the cognitive construction of judgments of forgiveness, blame, prosecution, revenge, resentment, and reconciliation in situations in which an individual is the victim of an act that could harm him or her [10]. In blame-like judgments (blame, prosecution, and revenge, i.e., from a prosecutorial perspective), individuals estimate the penalty appropriate for a harmful act. Individuals estimate the degree of sympathy toward the offender in forgiveness-like judgments (forgiveness, resentment, and reconciliation, i.e. from a theological perspective). Mullet et al.'s main finding were that the mean rating was lower in the forgiveness-like tasks than in the blame-like tasks; hence, there was a main effect of the type of judgment [10].

The present study sought to extend Decroix et al.'s research [9] by adding four other kinds of moral judgment: prosecution, revenge, resentment, and reconciliation, to answer the following two questions. Do older people with dementia differ from healthy people about blame-like and forgiveness-like moral judgments? And does Mullet et al.'s two-dimensional model of moral judgment apply to older people with dementia [10]?

Two of our three starting hypotheses were based on Decroix et al.'s results [9]. The first hypothesis was that older people with dementia would differ from young people and healthy older people about the number of information cues considered. We expected that young and healthy older people would take account of all the information cues present, and that older people with dementia would consider at most two information cues. The second starting hypothesis was that whatever the judgment task, older people with dementia would give more weight to the intent factor.

Our third starting hypothesis was based on Mullet et al.'s results [10] and Decroix et al.'s findings [9]. We expected that all three groups (young people, healthy older people, and older people with dementia would be able to differentiate between blame-like judgments and forgiveness-like judgments. We therefore expected to see a higher mean judgment level in a blame task (prosecution and revenge) than in a forgiveness task (resentment and reconciliation) [10].

2. Materials and Methods

This study was not pre-registered. The data and data analysis are available on the Recherche. data.gouv (https://doi.org/10.57745/HW0WSW).

2.1 Participants

We included three groups of participants. Firstly, 34 young people (*Mage* = 22.12, *SD* = 3.44, range: 20–23 years) were recruited from university students in the city of Calais (France). The second group was composed of 22 healthy older people (*Mage* = 71.82, *SD* = 8.69, range: 61–87 years) recruited randomly in the street. We excluded 14 participants because they were younger than 60 years. The people were given information about the study's objective and procedures and were asked if they wanted to participate. The third group included 18 older people with dementia (*Mage* = 75, *SD* = 10.06, Age range: 61–93 years) recruited at a residential home for dependent elderly adults. All types of dementia were included. The residential home's physician had diagnosed dementia as a chronic or progressive syndrome in which cognitive function was impaired. The differences in age between the young people and the healthy older people and between the young people and the older people with dementia were significant ($p < 0.001$). The difference in age between the healthy older people and the older people with dementia was insignificant ($p = 0.313$).

The participants were not paid. The participants' demographic characteristics are summarized in Table 1. For young people, the inclusion criterion was age between 20-23 years old and the exclusion criterion was a mental health concern. For older people, the inclusion criterion was to be older than 60, and the exclusion criterion was a mental health concern. For older people with dementia, the inclusion criteria were geriatrician-diagnosed dementia and an age above 60 years old**,** and an exclusion criterion was a Mini-Mental State Examination (MMSE) score <20 [11]. People with sensory impairments, severe behavioral disorders, and major depression were excluded. Depressive syndromes in old age may indicate the presence of prodromal dementia [12]. Major depression (as diagnosed by the residential home's physician) is a mental illness characterized by loss of pleasure, a sad mood for several weeks, sleep problems, changes in appetite, and the loss of concentration, energy, interest and/or motivation. Accordingly, participants with major depression were excluded.

Table 1 The participants' demographic characteristics.

Participants	Young People (34)	Healthy Older People (22)	Older People with Dementia (18)
Gender	Males (20) Females (14)	Males (7) Females (15)	Males (7) Females (11)
Age	M (22.03) SD (3.48)	M (71.82) SD (8.69)	M (75.22) SD (10.13)
Educational Level	Primary School (0) Secondary School (0) University (34)	Primary School (13) Secondary School (3) University (6)	Primary School (9) Secondary School (8) University (1)

2.2 Material

The material consisted of four questionnaires on prosecution, revenge, resentment, and reconciliation judgments. Each questionnaire comprised 12 scenarios (see the Appendix), corresponding to the orthogonal combination of three factors (2 × 3 × 2 = 12): Intention (accidental or intentional), Consequence (no consequences; moderate consequences; serious consequences), and Apology (apology or no apology). Each scenario consisted of a hypothetical story, a question, and a 20 cm visual analog rating scale ranging from "No at all" at the left anchor to "Totally" at the right anchor. The stories included situations in which an elderly person ("Fred") falls while being

washed by a nurse (“Julie”) [9]. The prosecution questionnaire asked "If you were Fred, would you take Julie to court?". The revenge questionnaire asked "If you were Fred, would you try to get your revenge on Julie?". The resentment questionnaire asked “If you were Fred, would you feel resentment towards Julie?”. Lastly, the reconciliation questionnaire asked "If you were Fred, do you think you would be friendly with Julie again?"

2.3 Procedure

The study was approved by an independent ethics committee (University of Midi-Pyrénées, Toulouse, France: reference: 2019-175). As mentioned above, the participants were given detailed information about the study’s objective and procedures. Furthermore, the participants were informed they could withdraw from the study whenever they wished.

By Anderson’s methodology [7-9], the overall procedure for the experiment involved a familiarization phase and then an experimental phase. The participants were presented with 3 of the 12 stories in the familiarization phase. The 3 stories were chosen to expose the participants to the full range of stimuli. In the experimental phase, the participants were presented with all stories. Each participant read each story and gave their rating. Participants were allowed to compare and modify their judgments during the familiarization phase but not during the experimental phase. No time limit was imposed.

2.4 Data Analysis

Using the G*Power 3 tool [13], the sample size was predetermined for a 3 (Group: young people, healthy older people, and older people with dementia) × 2 (Intention: accidental, intentional) × 3 (Consequence: no consequences, moderate consequences, serious consequences) × 2 (Apology: apology, no apology) mixed-factor analysis of variance (ANOVA). To detect an effect size with a Cohen’s f of 0.25 (based on the effect size corresponding to $\eta^2_p = 0.06$ for the Group factor in the blame judgment in [9]) with $\alpha = 0.01$ and a power of 0.80, the minimum sample size was 51 (i.e., 17 participants in each of the three groups).

The participant’s ratings on the response scale were converted into a numerical value by measuring the distance between the left anchor (the origin) and the mark. The distance data were then processed in graphical and statistical analyses. Data from the familiarization phase were not processed.

Separate ANOVAs with repeated measures were conducted. To test the effect of group, an ANOVA with Group × Judgment × Intention × Consequence × Apology (3 × 4 × 2 × 3 × 2) design was performed. To test our first two starting hypotheses, ANOVAs with 2 × 3 × 2 (Intent × Consequence × Apology) design were performed on each group and for each judgment. To test our third starting hypothesis, an ANOVA with a Judgment × Intention × Consequence × Apology (4 × 2 × 3 × 2) design was performed on each group. The data were analyzed using Statistica software (version 8, StatSoft Inc., Tulsa, USA).

3. Results

3.1 ANOVAs with a Group × Judgment × Intent × Consequence × Apology Design

Neither the Group factor ($F(2,71) = 1.38$, $p = 0.26$, $\eta^2_p = 0.04$) nor the Judgment factor ($F(3,213) = 3.34$, $p = 0.02$, $\eta^2_p = 0.04$) was statistically significant ($p < 0.01$ was significant). The Intent factor had a significant effect ($F(1,71) = 370.57$, $p < 0.001$, $\eta^2_p = 0.84$), as did the Consequence factor ($F(2,142) = 110.45$, $p < 0.001$, $\eta^2_p = 0.61$), and the Apology factor ($F(1,71) = 119.11$, $p < 0.001$, $\eta^2_p = 0.63$).

3.2 ANOVAs with an Intent × Consequence × Apology Design for Each Judgment

In the groups of young people and healthy older people, the Intent, Apology, and Consequence factors significantly affected the four moral judgments (Table 2). In the group of older people with dementia, only the Intent factor affected three judgments (prosecution, revenge, and reconciliation). The Intent and Consequence factors had a significant effect on judgments of resentment by older people with dementia. Whatever the judgment, the effect size was larger for Intent than for the other information cues.

Table 2 The main results of the ANOVAs performed on the moral judgment data from the three groups.

	Young people							**Healthy older people**							**Older people with dementia**						
	Effect		Error					Effect		Error					Effect		Error				
	df	MS	df	MS	F	**p**	η^2p	df	MS	df	MS	F	**p**	η^2p	df	MS	df	MS	F	**p**	η^2p
JUDGMENT OF PROSECUTION																					
Intention	1	5304.97	33	40.10	132.28	**<0.001***	0.80	1	3056.60	21	64.33	47.52	**<0.001***	0.69	1	6014.56	17	167.52	35.90	**<0.001***	0.68
Apology	1	1452.43	33	11.77	123.40	**<0.001***	0.79	1	986.40	21	33.65	29.31	**<0.001***	0.58	1	23.73	17	19.24	1.23	0.282	0.07
Consequence	2	832.11	66	12.26	67.85	**<0.001***	0.67	2	156.67	42	18.65	8.35	**<0.001***	0.28	2	15.23	34	21.21	0.72	0.495	0.04
JUDGMENT OF REVENGE																					
Intention	1	6281.57	33	62.62	100.32	**<0.001***	0.75	1	2040.19	21	60.16	33.91	**<0.001***	0.62	1	1788.251	17	127.152	14.06	**0.002***	0.45
Apology	1	1726.53	33	24.94	69.22	**<0.001***	0.68	1	508.80	21	20.22	25.17	**<0.001***	0.54	1	69.473	17	20.285	3.42	0.082	0.17
Consequence	2	292.22	66	11.32	25.81	**<0.001***	0.44	2	274.45	42	17.93	15.32	**<0.001***	0.42	2	8.311	34	2.593	3.21	0.053	0.16
JUDGMENT OF RECONCILIATION																					
Intention	1	4496.74	33	49.69	90.50	**<0.001***	0.73	1	2129.55	21	87.13	24.44	**<0.001***	0.54	1	5465.20	17	188.77	28.95	**<0.001***	0.63
Apology	1	1721.60	33	25.18	68.37	**<0.001***	0.67	1	800.12	21	45.33	17.65	**<0.001***	0.46	1	131.13	17	32.53	4.03	0.061	0.19
Consequence	2	547.15	66	16.41	33.34	**<0.001***	0.50	2	75.26	42	12.41	6.06	**0.004***	0.22	2	14.36	34	16.32	0.88	0.424	0.05
JUDGMENT OF RESENTMENT																					
Intention	1	4415.44	33	20.02	220.53	**<0.001***	0.87	1	3081.15	21	21.31	144.59	**<0.001***	0.87	1	6691.13	17	78.30	85.46	**<0.001***	0.83
Apology	1	1711.34	33	10.39	164.65	**<0.001***	0.83	1	768.07	21	8.62	89.10	**<0.001***	0.81	1	177.49	17	22.97	7.73	0.013	0.31
Consequence	2	1704.66	66	15.81	107.81	**<0.001***	0.77	2	1652.47	42	12.59	131.29	**<0.001***	0.86	2	261.70	34	24.57	10.65	**<0.001***	0.38

***** Threshold for statistical significance: $p < 0.01$

Figure 1 and Figure 2 show the effects of the Intention and Consequence factors on prosecution and revenge judgments (Figure 1) and on reconciliation and resentment judgments (Figure 2) by the three groups of participants. In each graph, the three levels of the Consequence factor are plotted on the x-axis, and the degree of judgment is assigned to the y-axis. A curve represents each degree of the Intention factor (accidental or deliberate).

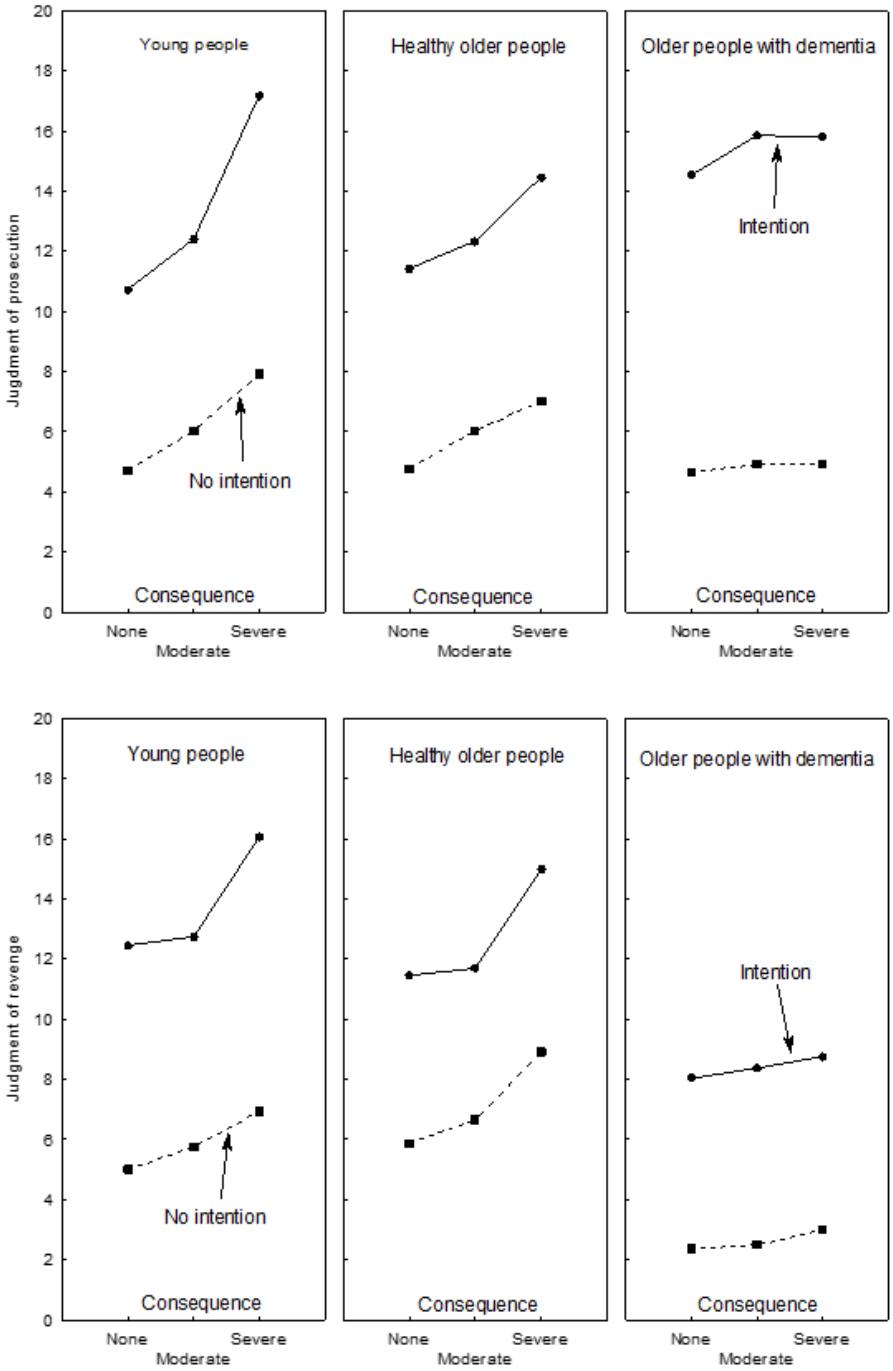

Figure 1 Effects of intention and consequence on the judgment of prosecution (upper panels) and the judgment of revenge (lower panels) by young people, healthy older people, and older people with dementia.

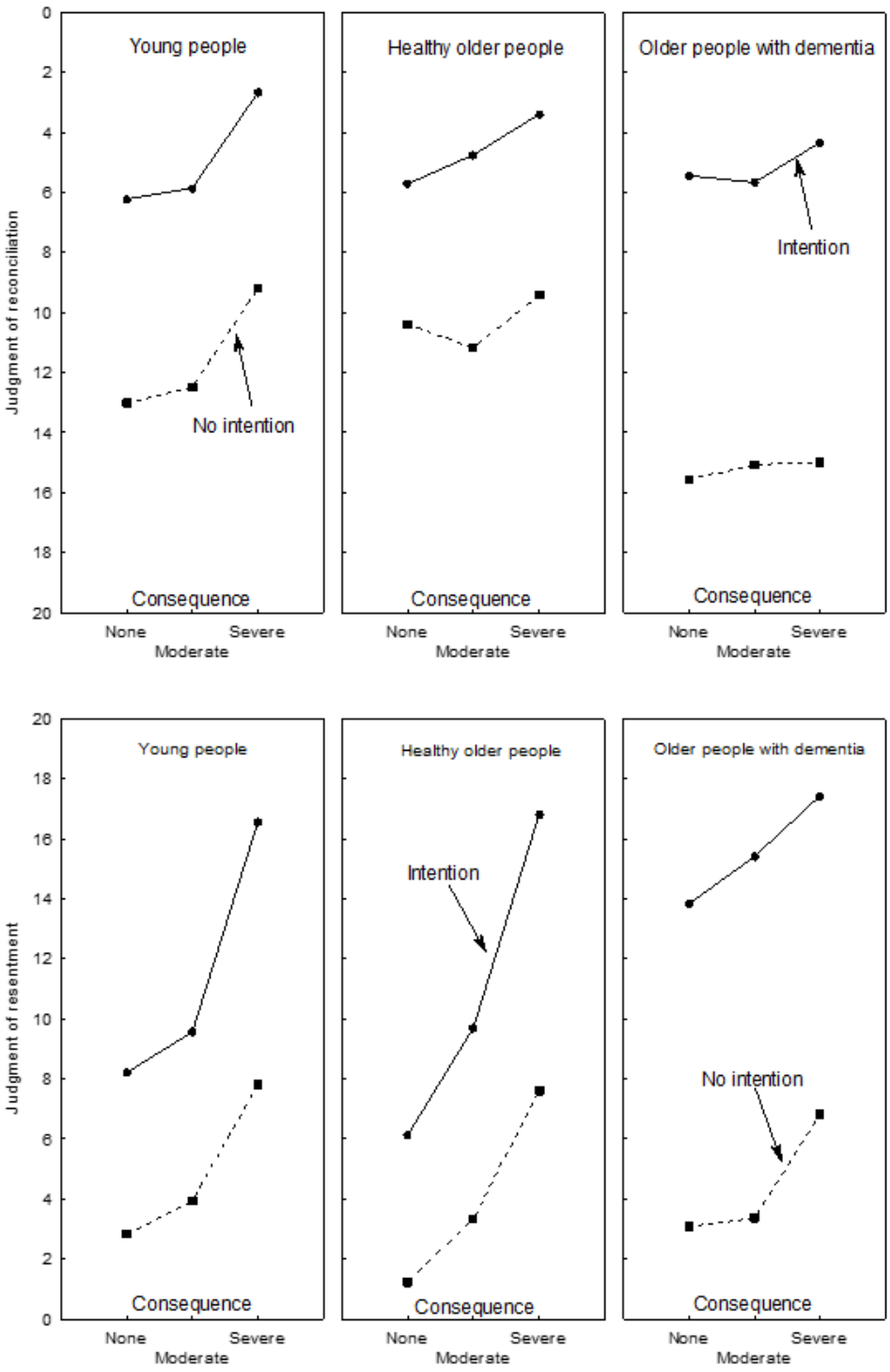

Figure 2 Effects of intention and consequence on the judgment of reconciliation (upper panels) and judgment of resentment (lower panels) by young people, healthy older people, and older people with dementia.

For blame-like judgments (prosecution and revenge) by young people (Figure 1, left panels) and healthy older people (Figure 1, middle panels), the effect of the Intention factor was reflected by the clear separation between the curves. The two curves rose from left to right: the more severe the consequence, the more the participants were willing to take the nurse to a court or get their revenge on the nurse. For older people with dementia (Figure 1, right panels), the two curves were

also separate – indicating a marked effect of the Intent factor. However, the curves were flatter than for the other groups - indicating that older people with dementia took less account of the consequence.

When considering forgiveness-like judgments (reconciliation and resentment), the scale for the reconciliation data was reversed. In other words, a 20-minus-the-raw-value transformation was applied so that the scales for reconciliation and resentment went in the same direction [10]. For young people (Figure 2, left panels) and healthy elderly people (Figure 2, middle panels), the two curves were separate - indicating a marked effect of the Intent factor. The two curves rose from left to right: the more severe the consequence, the more the participants did not intend to reconcile themselves with the nurse and the greater the degree of resentment toward the nurse. In older people with dementia (Figure 2, right panels), the curves were also distinct, signifying that the Intent factor had a strong effect. The curves for the judgment of resentment rose slightly; this means that the older population with dementia considered the Consequence factor (especially when the latter were severe): the more severe the consequence, the more resentful the older people with dementia were.

3.3 ANOVAs with a Judgment × Intention × Consequence × Apology Design

The Judgment factor was statistically significant for the young people, $F(3,99) = 5.77$, $p < 0.001$, $\eta^2_p = 0.15$. The mean blame-like judgment (prosecution ($M = 9.84$; $SD = 1.46$) and revenge ($M = 9.83$; $SD = 1.40$)) ratings were higher than the mean forgiveness-like judgment (resentment ($M = 8.15$; $SD = 0.98$) and reconciliation ($M = 8.24$; $SD = 1.40$) ratings. Fisher's post hoc test revealed significant differences for prosecution vs. resentment ($p = 0.003$), prosecution vs. reconciliation ($p = 0.005$), revenge vs. resentment ($p = 0.003$), and revenge vs. reconciliation ($p = 0.005$). No other statistically significant differences were found.

The Judgment factor was statistically significant for the healthy older people, $F(3,63) = 4.27$, $p = 0.008$, $\eta^2_p = 0.17$. The mean blame-like (prosecution ($M = 9.34$; $SD = 2.34$) and revenge ($M = 9.93$; $SD = 2.37$)) ratings were higher than the mean forgiveness-like (resentment ($M = 7.46$; $SD = 1.09$) and reconciliation ($M = 7.46$; $SD = 2.04$) ratings. Fisher's post hoc test revealed statistically significant differences for prosecution vs. resentment ($p = 0.035$), prosecution vs. reconciliation ($p = 0.035$), revenge vs. resentment ($p = 0.006$), and revenge vs. reconciliation ($p = 0.006$). No other statistically significant differences were found.

For the older people with dementia, the Judgment factor was statistically significant ($F(3,51) = 7.31$, $p < 0.001$, $\eta^2_p = 0.30$) but the judgment ratings differed. The mean blame-like (prosecution ($M = 10.12$; $SD = 2.48$) and revenge ($M = 5.52$; $SD = 3.71$)) ratings and the mean forgiveness-like (resentment ($M = 9.98$; $SD = 1.40$) and reconciliation $M = 10.18$; $SD = 1.61$) ratings were not significantly different. Fisher's post hoc test revealed significant differences between revenge vs. prosecution, and resentment vs. reconciliation ($p < 0.001$). No other statistically significant differences were found.

4. Discussion

The present study extended Decroix et al.'s research [9]. Four additional moral judgments were added, in order to compare the cognitive processes involved in blame-like judgments (prosecution

and revenge) and forgiveness-type judgments (reconciliation and resentment) in three groups of adults (young people, healthy older people and older people with dementia).

The study's results confirmed our first starting hypothesis, i.e., that older people with dementia would differ from young people and healthy older people about the number of information cues considered [9]. Young people and healthy older people used the three information cues (intent, consequence, and apology) for the four judgment tasks (prosecution, revenge, reconciliation, and resentment). Our results confirmed Decroix et al.' s findings [9], with no differences between young and healthy older people. Furthermore, older participants with dementia did not use the judgment tasks' three information cues the same way as the young and healthy older adults; they gave more weight to the Intent factor. Decroix et al. found that as the number of factors rose, older people with dementia could not combine them [9] – probably due to cognitive decline [14]. We observed differences in all three factors between people without dementia and older people with dementia. This finding confirmed that the cognitive processes involved in moral judgments differ in older people with dementia *vs.* young and healthy older people [8, 9].

Our second starting hypothesis was that older people with dementia prioritize the Intent factor for each type of judgment. Indeed, the *culpa* (intent to harm) component was given more importance. This is logical because the deliberate infringement of important moral values has major consequences. This is consistent with Decroix et al.'s finding that the impacts of consequence and apology were much weaker than the impact of intent in blame and forgiveness judgments by older people with dementia [9].

Our third starting hypothesis was that all participants could differentiate between blame-like judgments and forgiveness-like judgments [9, 10], translating into a higher mean rating in blame-like judgments than in forgiveness-like judgments. We confirmed the existence of this difference between healthy young people and healthy older people. Overall, participants found it easier to seek to prosecute the nurse and gain revenge than to avoid resentment or try to reconcile. Unsurprisingly, participants found it easier to blame than to forgive - probably because it is generally easier to adopt a prosecutorial perspective than a theological perspective when harmed by others [10]. In contrast, we did not observe a clear differentiation between blame-like and forgiveness-like judgments by older participants with dementia. From a neuropsychological perspective, the cognitive impairment in dementia might have influenced functional ability and perhaps the ability to group judgments into two categories [15].

4.1 Limitations, Practical Application, and Strengths of the Study

Our study had three main limitations. Firstly, we included significantly fewer healthy older adults and older adults with dementia than young adults. Secondly, we did not consider the stage of dementia in older people with dementia (e.g., by measuring the MMSE scores [11]), even though the latter is likely to influence cognitive processes [8]. Thirdly, we did not study the participants' education level or gender. Zahodne et al. showed that a higher education was associated with a higher cognitive level and slower cognitive decline [16]. Thus, a potential difference in education level between healthy older people and older people with dementia might have affected how information cues were considered [17]. Lastly, other statistical analyses (such as multivariable regression) could have been applied.

The prevalence of dementia among older adults continues to increase worldwide; hence, with a view to practical applications, it is becoming increasingly important to better understand cognitive aging. Judgment in everyday situations is an important aspect of cognition and warrants formal evaluation during neuropsychological assessments of older adults. The knowledge gained from this process can be used for diagnostic purposes and to address issues related to functional competence and the level of care required now and in the future [18].

Our study had several strengths. Firstly, we evaluated people with cognitive impairments in moral judgment by adapting the experimental material (i.e., presentation as pictograms). As suggested by Margoni et al., it is necessary to apply a new theoretical framework and new methods when investigating moral judgment among older people [2]. Age-related differences in moral evaluation might depend on the cognitive and motivational factors pointed out by Margoni et al. [3]. In order to motivate the participants, the study scenario described a familiar everyday situation that all participants could easily understand and so might have made them feel more concerned. Moreover, pictograms were included to make the scenario easier to understand (as described previously by Morales-Martinez et al. [19]). Experimental paradigms based on Anderson's information integration theory [7] enabled us to find evidence of moral cognitive processes in people with dementia.

A second strength of our study was the assessment of variants of blame judgments (prosecutorial judgments) and forgiveness judgments (theological judgments) with very different constructs. The usual consequences of assigning blame are the will to pursue in court (prosecutorial judgment) and the will to avenge (revenge judgment). In theory, blame, judicial compensation, and revenge allow the victim to regain some control over the offender and the situation [20]. The degree of indignation that is generally felt when a significant value is transgressed (resentment judgment) and the extent to which one feels ready to resume previous contact with the transgressor (reconciliation judgment) are the consequences of granting forgiveness [21].

In further research, we intend to (i) explore changes over time in judgment-related cognitive processes in older people with dementia [22] and (ii) study the effect of physical activity on information integration processes [23].

5. Conclusion

It is increasingly important to better understand the process of cognitive aging, as the prevalence of dementia among older people continues to increase worldwide. Judgment in everyday situations is an important aspect of cognition and requires formal evaluation during neuropsychological assessments of older individuals. The knowledge gained through this process could be used for diagnostic purposes and to solve problems related to functional competence [8].

Author Contributions

Dr Eric Fruchart and Patricia Rulence-Pâques were responsible for project development. Dr Valentin Decroix conducted data collection.

Competing Interests

The authors have declared that no competing interests exist.

Additional Materials

The following additional materials are uploaded at the page of this paper.

1. Appendix: the 12 scenarios.

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