Changes over time in information integration among older people with dementia: judgments of blame and forgiveness

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Abstract

The study explored the change over 15 months in how older people with dementia cognitively integrated three factors (Intention, Consequence, and Apology) when making judgments of blame and forgiveness. For each moral judgment, 8 older adults with dementia (M_{age} = 70.88; *SD* = 9.52) were confronted with a questionnaire comprising 12 scenarios (combinations of the three factors) at 3-month intervals. The questionnaire and the Mini-Mental State Examination (MMSE) were administered every 3 months. Several repeated-measures analyses of variance were conducted on the data from each questionnaire, and a t-test was performed on the MMSE scores at baseline and at 15 months. Despite a decrease over time in the MMSE score, the cognitive processes in information integration were stable over the 15 months. Only the intent factor was considered in both types of moral judgment. In clinical practice, these findings might be useful for preventing cognitive decline.

Keywords: change over time; judgment; dementia; information integration; cognition

Introduction

Age is a risk factor for developing dementia (Helmer et al., 2006; Olin et al., 2002). Dementia involves a noticeable decline in cognitive abilities (DSM-V; American Psychiatric Association, 2013). There are no curative treatments available (World Health Organization, 2020).

Folstein et al. (1975) created the Mini-Mental State Examination (MMSE) to screen for significant neurocognitive impairment. A declining score over time indicates a worsening cognitive impairment in the individual. Longitudinal studies using the MMSE provide insight into the trajectory of cognitive decline and the factors influencing it. In a study by Suh et al. (2004), the functional abilities of people with mild-to-moderate dementia were observed to decline significantly over a six-month period. Despite the use of inhibitors, Helmer et al. (2007) noted the progression of Alzheimer's disease, indicated by a statistically significant decrease in the MMSE score after six and eighteen months. Cortes et al. (2008) assessed dementia levels every six months for two years and found a significant decrease of seven points in the MMSE score. Nourhashémi et al. (2008) reported an increase in cognitive decline among individuals with initially mild cognitive impairment. Mungas et al. (2010) monitored cognitive aging for an average of 2.9 years and observed a heterogeneous pattern of changes in cognitive abilities among participants. These findings showed that a decrease in the MMSE score is a good guide to cognitive decline over time in seniors with dementia.

Dementia has broader implications than just cognitive decline. It also affects the cognitive processes when establishing moral judgments. Fontaine et al. (2004) and Decroix et al. (2021, 2023) conducted research studies based on Anderson's information integration framework (1996, 2008) to understand how individuals combine various factors when making moral judgments. Decroix et al. (2021) extended Fontaine et al.'s (2004) study by comparing healthy young adults, healthy older adults, and older adults with dementia in terms of their

judgments of blame and forgiveness. They tested the number of factors that older adults with dementia could integrate to make moral judgments in everyday life situations. The situations depicted familiar situations for older people, like a nurse assisting with home showering, where the older person fell due to an incident. They were based on different combinations of factors, including intention, consequence, apology, negligence, and relational proximity. Decroix et al. (2021) indicated that older adults with dementia struggled to consider more than two factors when making moral judgments and consistently prioritized intention. Decroix et al. (2023) also highlighted that dementia negatively impacted judgments concerning blame (prosecution and revenge) and forgiveness (reconciliation and resentment). However, these studies did not investigate how the integration of information in moral judgments changed over time in individuals with dementia.

The objective of our longitudinal study was to investigate possible changes over time in the cognitive processes in information integration, i.e., the manner in which Intention, Consequence, and Apology factors were combined in blame and forgiveness judgments over a 15-month period by older people with dementia. We considered three hypotheses. Firstly, at the beginning of the study (T0), older people with dementia would give greater importance to the intention factor in both blame and forgiveness judgments (Decroix et al., 2021, 2023). Secondly, MMSE scores would be lower at 15 months (T15) compared to the baseline (T0) (Cortes et al., 2008). Thirdly, cognitive processes related to information integration would become more impaired over time (Nourhashémi et al., 2008).

Material and method

Participants

The participants included eight older adults with dementia (*Mage* = 70.88, *SD* = 9.52; 5 women and 3 men) from a residential home for dependent older adults in France. Inclusion criteria was a dementia diagnosis by the residential home's physician, an MMSE score <20,

and the absence of severe visual or hearing impairment, major depression or serious behavioral disorders. The participants were not paid. They provided informed consent, either written or verbal with written consent from a family member or legal guardian when necessary. Lastly, to perform the experiment, the investigator made an appointment with the participant (or parent or legal guardian). Data collection started in 2020 and ended in 2021.

Material

The materiel consisted of two questionnaires (Decroix et al., 2021) with 12 scenarios (Appendix), involving three factors (Intention, Apology, Consequence). Pictograms aided scenario comprehension, following Morales-Martinez et al. (2015). Each scenario included a story, a question, and a 20 cm rating scale ("Not at all" to "Totally"). Scenarios depicted an older person ("Pierre-Yves") falling while being washed by a nurse ("Catherine"). In the blame questionnaire, participants rated Catherine's blame. In the forgiveness questionnaire, they assessed forgiving Catherine from Pierre-Yves' perspective. Additionally, participants completed the MMSE.

Procedure

The study was not pre-registered. It obtained ethical approval (number 2019-175) and consent from the residential home director. All participants responded individually. Half received blame scenarios first, followed by forgiveness scenarios, and the other half received scenarios in reverse. The procedure mirrored Decroix et al.'s (2021) study. Blame and forgiveness judgments were collected at 3-month intervals (T0 = 0 months, T3 = 3 months, T6 = 6 months, T9 = 9 months, T12 = 12 months, T15 = 15 months), with MMSE administered every 3 months.

Data analysis

Participants' ratings on the response scale were quantified by measuring the distance from the left anchor (origin) and subsequently utilized in graphical and statistical analyses.

To test the first and third hypotheses, separate repeated-measure ANOVAs were conducted on both questionnaires (blame and forgiveness). The first ANOVA utilized a factorial design (6 x 2 x 2 x 3; Time x Intention x Apology x Consequence), treating Time as an inter-subject variable, and Intention, Apology, and Consequence as independent variables, with moral judgment as the dependent variable. Additional ANOVAs followed a factorial design (2 x 2 x 3; Intention x Apology x Consequence) for each time point (T0= 0 months; T3= 3 months; T6= 6 months; T9= 9 months; T12= 12 months; T15= 15 months).

A Student's t-test tested the second hypothesis and compared MMSE scores between T0 and T15. Data analysis was carried out using Statistica software (Weiß, 2007), with no data exclusions. The de-identified data are available on the Recherche.Data.Gouv (https://doi.org/10.57745/QVJORB).

Results

MMSE

The mean MMSE score at T15 (M = 23.13; SD = 1.43) was lower than the mean MMSE score at T0 (M = 27.00; SD = 1.49; $t(7) = 3.78$, p = .007, d = 1.34; Table 1).

Judgments of blame

Two ANOVAs were conducted on data from judgments of blame. In the first ANOVA (6 x 2 x 2 x 3), the Time factor did not have a significant effect on blame judgment ($F(5,42) = 0.04$, p = .999. $\eta^2_p = .00$). Table 1 shows the means of blame judgment by the older adults with dementia at each time. The mean scores did not vary over time.

The results of the second ANOVAs following the factors design 2 x 2 x 3 (Intent x Apology x Consequence) are presented in Table 2. Only the Intention factor had a significant effect on blame judgment whatever the time considered. The Apology and Consequences factors and the three factor-interaction were not significant at each time.

Figure 1 shows the combined effect of Intent, Consequences and Apology on blame judgment at each time. The pairs of graphs correspond to Time T0 to T15, respectively. In each pair, each graph corresponds to a degree of the Apology factor (apology or not). The three degrees of the Consequence factor are placed on the x-axis, and the level of blame judgment is indicated on the y-axis. Both curves correspond to the two degrees of the Intention factor (accidental or deliberate).

In each graph, the two curves are clearly separated, indicating a marked effect of the Intention factor, meaning that the stronger the intention, the more blamed the nurse. The two curves are approximately parallel to the x-axis, indicating that the consequence of the act has no significant effect on blame judgment. At each time, the form of curves in each graph is identical, showing that both degrees of the Apology factor have not been differentiated by participants.

Judgments of forgiveness

Two ANOVAs were performed on data from judgments of forgiveness. In the first ANOVA (6 x 2 x 2 x 3), Time did not have a significant effect ($F(5,42) = 0.02$, $p = .999$. $\eta^2_p = .00$) on forgiveness judgments. The mean for forgiveness judgments did not vary over time (Table 1).

In the second ANOVA with a 2 x 2 x 3 (Intent x Apology x Consequence) factor design (Table 2), only the Intention factor had a significant effect - regardless of the time period considered. The Apology and Consequence factors were not significant at any time point.

Figure 2 shows the combined effect of Intent, Consequences and Apology factors on forgiveness judgments at each time point. The six pairs of graphs correspond to T0 through T5. In each pair, the two graphs correspond to the degree of the Apology factor (apology in one graph and no apology in the other). The three degrees of the Consequence factor are placed on the x-axis, and the level of blame judgment is indicated on the y-axis. The two curves correspond to the two degrees of the Intention factor (accidental or deliberate).

In each graph, the two curves are clearly separated, indicating that older adults with dementia mainly considered the Intention factor. The stronger the intention, the less likely they were to forgive. At each time point, the curves' position and shape are practically identical in the left and right graphs; this indicates that the Apology factor had no effect on forgiveness judgments. The fact that the curves are almost flat indicates that the Consequence factor had no effect on forgiveness judgments.

Discussion

The objective of our study was to assess the change over time (every 3 months) in cognitive processes in information integration, i.e., how Intention, Consequence, and Apology factors were combined in moral judgments of blame and forgiveness.

Our first hypothesis was that the older people with dementia would give greater importance to the Intention factor in both types of moral judgment at time T0 (Decroix et al., 2021, 2023). The results confirmed that Intention appeared to be an invariant factor (Decroix et al, 2021, 2023). Considering Intention alone may be due to the cognitive impairment associated with dementia (American Psychiatric Association, 2013).

Our second hypothesis was that the MMSE score would be lower at 15 months (T15) than at baseline (T0) (Cortes et al., 2008). The mean MMSE scores decreased by 4 points over the 15-month study period. That is in line with the literature reports of age-related cognitive declines in the MMSE score (Suh et al., 2004; Cortes et al., 2008; Nourhashémi et al., 2008).

Given that cognitive ability declines over time in older people with dementia (Nourhashémi et al., 2008), our third hypothesis was that cognitive processes in information integration would be impaired over time. This hypothesis was not confirmed: the cognitive processes in information integration remained stable until the end of follow-up. Throughout the study, older people with dementia only considered the Intention factor. This stability of the information integration process can be considered through from the concepts of fluid intelligence and crystallized intelligence (Cattell, 1971).

Some researchers have studied the impact of dementia on fluid and crystallized intelligences in older adults with dementia. Grober et al. (2008) found that patients with dementia showed a decline in markers of fluid intelligence but not in those of crystallized intelligence. Harrington et al. (2018) studied the effect over time of preclinical Alzheimer's disease on crystallized and fluid intelligence and the relationship between the two. With evaluations every 18 months over a period of 6 years, they found that (i) the impairment in fluid intelligence occurs more rapidly in adults with preclinical Alzheimer's disease than in healthy older adults, and (ii) this difference was not observed for crystallized intelligence.

We suggest that fluid intelligence was impaired in the older adults described in Decroix et al.'s studies (2021, 2023). Indeed, the study task required cognitive processing of the information cues presented. The task might have involved the maintenance of these information cues in working memory (Kane & Engle, 2002) to make a judgment. This judgment required the ability to analyze the situations presented, consider the factors, and weight them through subjective logic. Decroix et al.'s (2021, 2023) results confirmed the decline in fluid intelligence caused by dementia (Harrington et al., 2018).

In the present study, the stability of our results might attest to the presence of a threshold for the deterioration of fluid intelligence in dementia. At some point, crystallized intelligence might take over from fluid intelligence. In our study, participants were faced with an everyday situation that might be part of their knowledge acquired over time. This knowledge would constitute crystallized intelligence, which is reportedly not impacted by dementia (Harrington et al., 2018). The older adults with dementia might not have been able to use their fluid intelligence and so called upon their crystallized intelligence. This would mean that dementia-related changes in cognitive ability might be more complex than a distinction between fluid intelligence and crystalized intelligence (Hartshorne et al., 2015).

Limitations, practical applications and perspectives

Our study had limitations: no distinction among dementia types, no determination whether the stability of information integration process was associated with a particular dementia subtype. We only examined blame and forgiveness judgments. Other blame-like and forgiveness-like judgments could be investigated (Decroix et al., 2023; Mullet et al., 2007). Our study included a small number of participants. Future investigation will complete our preliminary new findings.

As the global elderly dementia population rises, understanding cognitive aging is crucial (World Health Organization, 2020). The dementia plan (World Health Organization, 2017) encourages to prevent risk factors for dementia. The MMSE (Folstein et al., 1975) quantitatively diagnoses dementia, while our study offers a qualitative cognitive assessment. These quantitative and qualitative approaches might be complementary. Evaluations of moral judgments would help to detect symptoms of dementia at an early stage and thus facilitate prevention. The knowledge gained through this process can be used to diagnose problems related to functional competence.

Various factors, such as education and leisure activities, may reduce dementia's cognitive impact (Wang et al., 2012). Physical activity can help preserve fluid intelligence (Kachouri et al., 2022) and benefit dementia-related cognitive function (e.g., Hernandez et al., 2010). Future research should explore optimizing cognitive function through exercise.

Declaration of Conflicting Interests: The Author(s) declare(s) that there is no conflict of interest

Appendix: the 12 scenarios

Catherine is a nurse  . She comes to help wash Pierre-Yves  , an 85-year-old person living alone at home  .

During the shower  , Catherine gets very annoyed  by Pierre-Yves's lack of cooperation, and she turns the tap so that the water becomes very, very cold  . Pierre-Yves is surprised, moves back, loses his balance, and falls over  .

After his fall, Pierre-Yves has to stay in hospital and is examined by a doctor  . Everything is fine, Pierre-Yves has not broken any bones, and his fall will not have any consequences  . Pierre-Yves goes home on the same day  .

Catherine visits Pierre-Yves and apologizes  .

Catherine is a nurse  . She comes to help wash Pierre-Yves  , an 85-year-old person living alone at home  .

During the shower  , Catherine gets very annoyed  by Pierre-Yves's lack of cooperation, and she turns the tap so that the water becomes very, very cold  . Pierre-Yves is surprised, moves back, loses his balance, and falls over  .

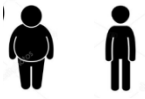
After his fall, Pierre-Yves has to stay in hospital and is examined by a doctor  . Everything is fine, Pierre-Yves has not broken any bones, and his fall will not have any consequences  . Pierre-Yves goes home on the same day  .

Catherine does not visit Pierre-Yves and she does not apologize  .

Catherine is a nurse  . She comes to help wash Pierre-Yves  , an 85-year-old person living alone at home  .

During the shower  , Catherine gets very annoyed  by Pierre-Yves's lack of

cooperation, and she turns the tap so that the water becomes very, very cold  . Pierre-Yves is surprised, moves back, loses his balance, and falls over  .

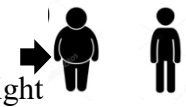
After his fall, Pierre-Yves has to stay in hospital  for two weeks and loses a lot of weight  .

After his two weeks in hospital, Pierre-Yves goes home  but has to walk with a stick  .

Catherine visits Pierre-Yves and apologizes  .

Catherine is a nurse  . She comes to help wash Pierre-Yves  , an 85-year-old person living alone at home  .

During the shower  , Catherine gets very annoyed  by Pierre-Yves's lack of cooperation, and she turns the tap so that the water becomes very, very cold  . Pierre-Yves is surprised, moves back, loses his balance, and falls over  .

After his fall, Pierre-Yves has to stay in hospital  for two weeks and loses a lot of weight  .

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After his fall, Pierre-Yves has to stay in hospital for 3 months  and is never able to walk again  .

Catherine visits Pierre-Yves and apologizes  .

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After his fall, Pierre-Yves has to stay in hospital for 3 months  and is never able to walk again  .

Catherine does not visit Pierre-Yves and she does not apologize  .

Catherine is a nurse  . She comes to help wash Pierre-Yves  , an 85-year-old person living alone at home  .

During the shower  , the water becomes very, very cold  because of a problem with the boiler  . Pierre-Yves is surprised, moves back, loses his balance, and falls over  .

After his fall, Pierre-Yves has to stay in hospital and is examined by a doctor  . Everything is fine, Pierre-Yves has not broken any bones, and his fall will not have any consequences  . Pierre-Yves goes home on the same day  .

Catherine visits Pierre-Yves and apologizes  .

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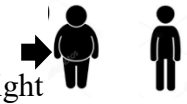
After his fall, Pierre-Yves has to stay in hospital  for two weeks and loses a lot of weight  .

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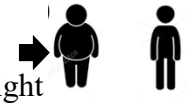
After his fall, Pierre-Yves has to stay in hospital  for two weeks and loses a lot of weight  .

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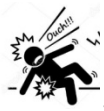
During the shower  , the water becomes very, very cold  because of a problem with the boiler  . Pierre-Yves is surprised, moves back, loses his balance, and falls over  .

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Table 1.

The mean (M) and standard deviation (SD) MMSE score for each moral judgment, measured at five time points

Time	***MMSE score***		***Blame judgment***		***Forgiveness judgment***	
	M	*SD*	*M*	*SD*	*M*	*SD*
T0	*27.00*	*4.21*	*9.63*	*1.22*	*11.14*	*1.17*
T3	*27.00*	*4.21*	*9.00*	*1.22*	*11.29*	*1.17*
T6	*23.63*	*5.07*	*9.08*	*1.22*	*11.54*	*1.17*
T9	*23.38*	*4.98*	*8.96*	*1.22*	*11.32*	*1.17*
T12	*23.13*	*4.98*	*9.12*	*1.22*	*11.56*	*1.17*
T15	*23.13*	*4.12*	*9.21*	*1.22*	*11.34*	*1.17*

Table 2
The main results of ANOVAs of blame and forgiveness judgments at five time points

	BLAME							FORGIVENESS						
	Effect		Error					Effect		Error				
Factor	*df*	*MS*	*df*	*MS*	*F*	*p*	η^2_p	*df*	*MS*	*df*	*MS*	*F*	*p*	η^2_p
				T0							**T0**			
Intention	1	4101.63	7	177.43	23.12	.001*	.77	1	3292.38	7	257.22	12.80	.009*	.65
Consequence	2	0.65	14	1.46	0.65	.650	.06	2	4.46	14	3.41	1.31	.302	.16
Apology	1	4.04	7	1.72	2.35	.169	.25	1	103.33	7	65.22	1.58	.248	.18
Intent x Consequence x Apology	2	5.08	14	2.39	2.12	.156	.23	2	0.31	14	0.27	1.14	.347	.14
				T3							**T3**			
Intent	1	4946.45	7	133.40	37.08	<.001*	.84	1	4361.86	7	225.92	19.31	.003*	.73
Consequence	2	0.96	14	1.54	0.62	.550	.08	2	0.72	14	1.42	0.51	.613	.07
Apology	1	4.04	7	4.47	0.90	.373	.11	1	68.18	7	58.35	1.17	.316	.14
Intent x Consequence x Apology	2	2.25	14	1.72	1.31	.302	.16	2	0.45	14	0.22	2.10	.158	.23
				T6							**T6**			
Intent	1	4050.80	7	143.60	28.21	.001*	.80	1	2823.17	7	245.43	11.50	.011*	.62
Consequence	2	2.56	14	3.31	0.78	.479	.10	2	0.77	14	9.67	0.08	.924	.01
Apology	1	23.60	7	6.86	3.44	.106	.33	1	168.01	7	56.18	2.99	.127	.30
Intent x Consequence x Apology	2	5.07	14	4.27	1.19	.333	.14	2	0.62	14	5.31	0.12	.891	.02
				T9							**T9**			
Intent	1	4514.15	7	136.78	33.00	<.001*	.82	1	3116.76	7	256.05	12.17	.010*	.63
Consequence	2	2.23	14	1.25	1.79	.203	.20	2	1.37	14	2.01	0.68	.521	.09
Apology	1	13.13	7	4.66	2.82	.137	.29	1	155.55	7	66.83	2.33	.171	.25
Intent x Consequence x Apology	2	10.49	14	5.78	1.81	.199	.21	2	5.51	14	2.19	2.51	.117	.26
				T12							**T12**			
Intent	1	4006.75	7	132.74	30.18	<.001*	.81	1	3042.00	7	267.11	11.39	.012*	.62
Consequence	2	2.05	14	1.39	1.47	.263	.17	2	0.38	14	3.36	0.11	.894	.02
Apology	1	27.09	7	8.91	3.04	.125	.30	1	171.20	7	73.54	2.33	.171	.25
Intent x Consequence x Apology	2	4.15	14	4.54	0.91	.423	.11	2	1.03	14	2.44	0.42	.665	.06
				T15							**T15**			
Intent	1	3921.93	7	135.29	28.99	.001*	.80	1	2803.68	7	250.23	11.20	.012*	.62
Consequence	2	0.17	14	1.44	0.12	.887	.01	2	2.43	14	7.39	0.33	.726	.04
Apology	1	21.09	7	6.29	3.35	.109	.32	1	163.80	7	73.26	2.24	.178	.24
Intent x Consequence x Apology	2	6.44	14	4.54	1.41	.275	.17	2	0.36	14	0.89	0.40	.679	.05

*Threshold for statistical significance: p<.05

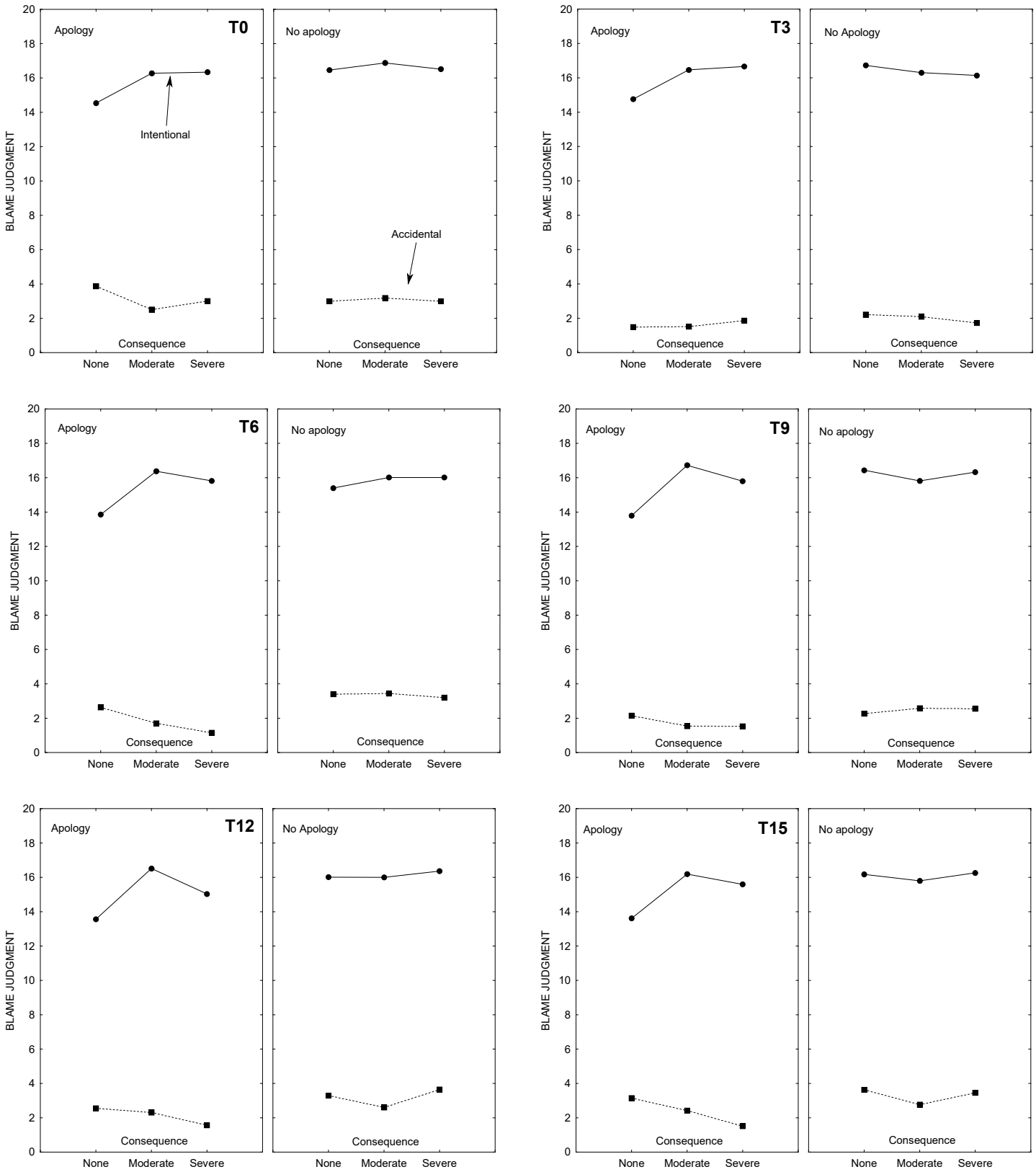

Figure 1. Effects of intention, apology, and consequence on a blame judgment at each time point (three-month intervals) by older people with dementia.

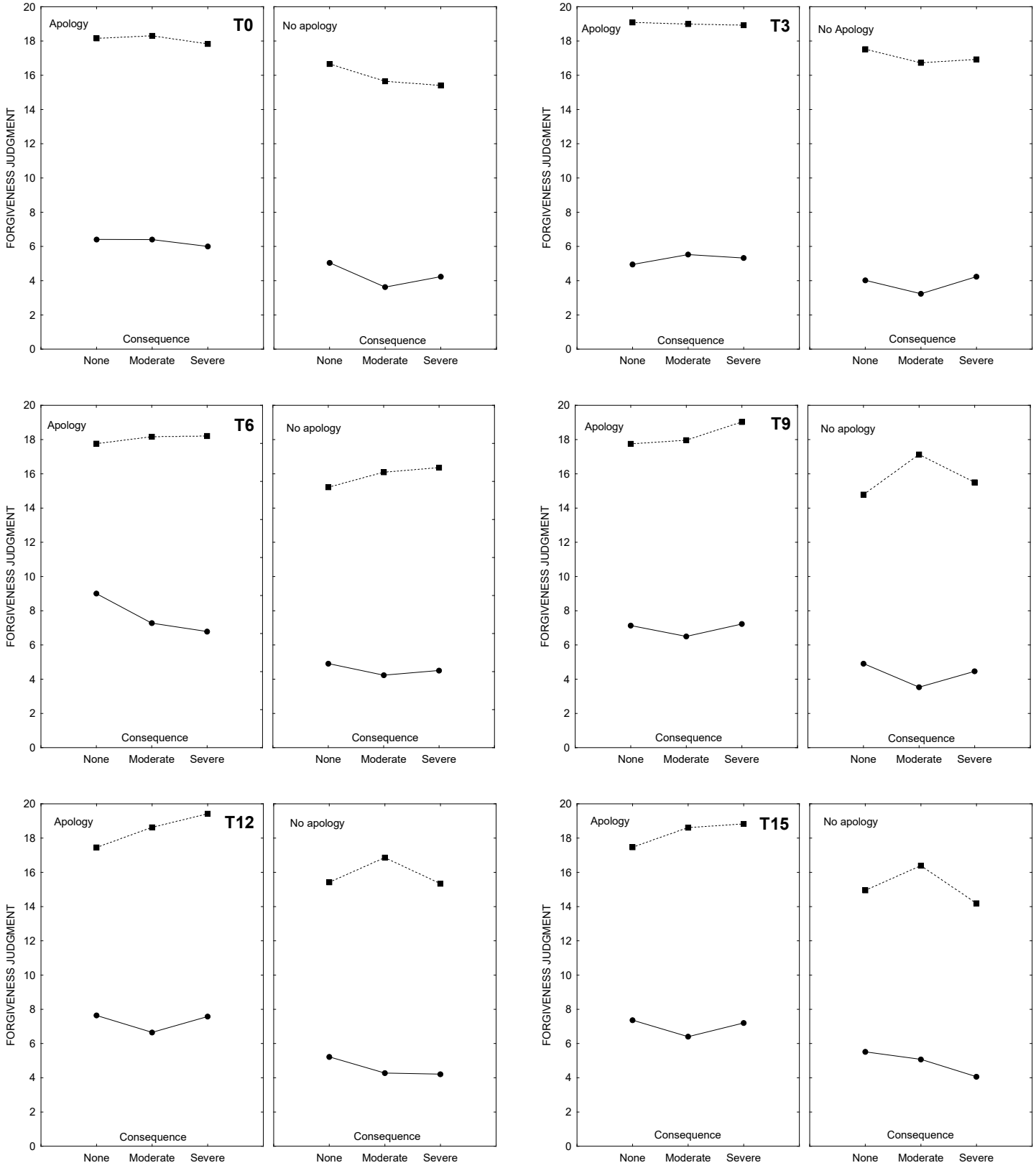

Figure 2. Effects of intention, apology, and consequence on a forgiveness judgment at each time point (three-month intervals) by older people with dementia.