INDIVIDUAL EVIDENCE OF INDEPENDENCE IN HEALTH PROFILES EVALUATION[*]

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A B S T R A C T

We analyze empirically the fulfillment of the property of Mutual Independence, traditionally assumed in the literature on health profiles evaluation. Mutual Independence turns out to be equivalent to the simultaneous fulfillment of two weaker properties: Independence of the Past with regard to the Future and Independence of the Future with regard to the Past. The purpose of this paper is to test if the latter property is better fulfilled than its alternative of Independence of the Past with regard to the Future, and than the stronger one of Mutual Independence. To do so, we propose three different sets of questionnaires, addressed to three groups of people, differing in age. Our main findings are the following: (1) at an aggregate level, Mutual Independence is accurately satisfied, even though there is a higher level of satisfaction of Independence of the future with regard to the past, particularly significant withing the Elderly group; (2) at an individual level, Independence of the future with regard to the past is significantly better fulfilled than the alternative assumption, for every group.

KEYWORDS: Health profile; Preference Independence; QALY.

1. Introduction

Quality-Adjusted Life Years (QALY) is the most common instrument with utilitarian foundations used to measure effectiveness in health care evaluation. Each possible outcome of a medical treatment can be assigned a particular number of QALYs. Health outcomes are represented by health profiles that indicate the state of health an individual will enjoy during a certain number of periods, after treatment. The general form of the QALY model (see [1], [2] and [3]) involves an additive structure of the following type:

$$QALYs(x_1, .., x_n) = \Sigma_{t=1}^{n} U_t(x_t)$$

where n stands for the life-span of an individual, $x = (x_1, ..., x_n)$ describes his health profile, that is, x_t is simply the state of health of the individual at period t, $t = 1, .., n$, and function U_t assigns a number between 0 and 1, understood as the "utility" of health state x_t, to each state x_t.

The main advantage of the QALY system of measurement is its simplicity. The additive structure implies that, in order to estimate the overall utility of a profile, we simply add up those QALYs generated at every period (measured by means of functions U_t). Nonetheless, the additive structure implies that agent's preferences on health profiles satisfy a property called *Mutual Independence*. This property states that in choosing between two alternative profiles, such that they coincide in some period, the common health state, wathever it is, can be ignored. That is, if in comparing two alternative profiles $x = (x_1, ..., x_n)$ and $y = (y_1, ..., y_m)$, it happens that for some $t \leq \min\{n, m\}$, $x_t = y_t$, and we prefer x to y, then if we consider profiles $x' = (x'_1, ..., x'_n)$ and $y' = (y'_1, ..., y'_m)$, where $x'_t = y'_t \neq x_t$, and $x_i = x'_i$, $y'_i = y_i$ for all $i \neq t$, we should still prefer x' to y'. In other words, if the state of health of the tied period is changed by a different state of health, the preference does not switch. Treadwell [4] presents evidence of the satisfaction of the assumption of Mutual Independence at an aggregate level.

Nonetheless, the property of Mutual Independence has been strongly criticized in the literature, from an individual point of view. Loomes & McKenzie [5] say that one's attitude about his current health state can depend on expectations about his future health:

...an individual who experiences several months of moderate discomfort as part of a treatment which he expects to result in improvements may place a rather different value on the experience compared with an individual for whom the same period in the

same state of discomfort is seen as a phase in a degenerative illness, with a much lower expectation of recovery...[page 303].

Previous criticism indicates that, in the individual evaluation of health profiles, Mutual Independence is too strong a requirement. Actually, Mutual Independence is equivalent to the simultaneous fulfillment of two weaker independence properties: *Independence of the Future with regard to the Past*, and *Independence of the Past with regard to the Future.* The former property only considers profiles tied at the initial periods, while the latter property only considers profiles tied at the final periods. Both state that variations in such common values do not influence preferences.

Common sense and introspection coincide in assigning a better adequacy of *Independence of the Future with regard to the Past* in the preferences elicited by individuals. The sort of utility functions that are consistent with such a property have been analyzed in [6] and another work of Guerrero & Herrero. Instead of an additive structure, a semi-separable one emerges, such that health states in previous periods influence the overall evaluation of a health profile.

The purpose of this paper is to test whether the property of *Independence of the Future with regard to the Past* is better fulfilled by individuals than its alternative of *Independence of the Past with regard to the Future,* and than the stronger one of *Mutual Independence.* To do so, we carried out a study using three different sets of questionnaires, depending on the target population were aimed at. The subjects of the first group were students from the University of Alicante between 18 and 20 years old; the second group of agents were people between 21 and 64 and, finally, the third group of people older than 65. They were all confronted with several questions. From their responses, we analyzed the relative fulfillment of the three alternative independence assumptions mentioned above.

We obtain similar results from all of the age groups. At an aggregate level, as in [4], we get that mutual independence is accurately satisfied, even though there is a higher level of satisfaction of *Independence of the Future with regard to the Past,* particularly significant among the elderly group. Notwithstanding, if we focus on the individual level, a significant difference in satisfaction is appreciable between the two assumptions. In this respect, our results support the alternative theoretical model in [6] more than that of [4].

Apart from the population diversity, there are other differences between our questionnaires and the one in [4]. We include some questions involving risky profiles, while theirs are all under certainty. We consider profiles of different durations, while theirs is fixed. They considered three states of health, all of which

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were pretty mild, while we consider four states, associated with a great number of illnesses, some of which were severe. They focused only on an aggregate analysis, while we also deal with the individual level.

The paper is organized as follows: In Section 2 we describe the methodology used in the construction of the questionnaires, and the tests derived from them. In Section 3 we report the results at both an aggregate and an individual level. Section 4 concludes with some comments. The Appendices include: the description of the health states used; an example of the type of questions posed to the agents; a complete description of the tests performed; and a summary of the results obtained in each test.

2. Methodology

2.1. Subjects

We perform a study involving 109 people. They were divided into three age groups. *Young,* 49 students from the University of Alicante, between 18 and 20 years old, enrolled in different undergraduate studies. *Middle-aged,* 47 people between 20 and 65 with different professional activities, and *Elderly,* 13 retired people of over 65 years. Our sample then, seems to be more representative of the general population than when students alone are considered. In all cases, a personal interview, conducted by experts, was performed.

2.2. Health States

Four health states are used in our study. They are described in *Appendix 1*: **A**, excellent health state, **D**, severe health state, and two intermediate health states, **B** and **C**. In order to describe those health states, we use just two attributes: (1) general ability to perform tasks at home and/or work, and (2) pain and/or other complaints. These two attributes are related to two effects on health conditions observed in many diseases. These health states are naturally ordered as: $\mathbf{A} \succ \mathbf{B} \succ \mathbf{C} \succ \mathbf{D}$.

Different combinations of previous health states give rise to different *health profiles or situations.* In each case, these situations are understood as being *possible* from *now* onwards. These situations are considered as *final* situations in the sense that they identify the individual's *future* case history as complete, i.e., the total number of years of each "chronic" health state, the sequence, and the time of death. For the *young* group, we present profiles of a maximum horizon of

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55 years, this is reduced to 30 years for the *Middle-aged* group of agents, and to 15 for the *elderly* group.

Agents face questions that always involve two alternative situations. In some cases, the decisions are made in a risky scenario: a *contingent situation* is presented to the agent. Thus, two alternative profiles are possible, each one with some probability. Uncertainty is associated with the application of medical treatment in such a way that there is a high probability (95% for young people, and 90% otherwise) of success, and a low probability (5% and 10% respectively) of failure. Probabilities were chosen in line with the usual likelihood of success physicians consider suitable to propose a given medical treatment to a patient.

In *Appendix 2* we present an example of such a question. In this particular example, two alternatives, one certain (S1) and the other contingent (S2), are proposed to the agent.

2.3. Design and Materials

The health profiles proposed to the agents are quite diverse. Health situations do not have a fixed life-span, namely, *duration* of life is a relevant variable. They correspond to non-chronic health profiles, so that, different health states appear in each situation. A typical health situation is described by two/three intervals of time during which the health state is kept constant. Thus, the basic attributes of a health situation are: its "chronic" intervals; the duration of the different chronic intervals, the health state during each chronic interval, and the sequence of chronic intervals. An example of a particular health profile is described as follows: the initial chronic interval consists of 10 years in health state **A,** the second chronic interval consists of 10 years in health state **C,** and, finally, the final chronic interval is of two years in health state **B.** Graphically,
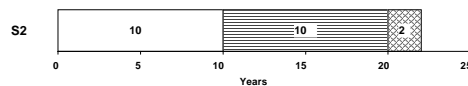
Agents of each age group face different questions. Out of their responses, three types of tests can be performed. The aim of the first test is to check whether

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individuals fulfill *independence of the future with regard to the past.* To do so, we compare the answers to pairs of choices in which the alternative situations proposed are tied on the *initial chronic period.* Tables 1, 3 and 5 correspond to this type of choice for young, Middle-aged-aged and elderly groups, respectively.

By way of example, look at Table 1, test 1.4. *Independence of the future with regard to the past* is fulfilled if, simultaneously, S1 is preferred to S2 and S1' is preferred to S2', or if, simultaneously, S2 is preferred to S1 and S2' is preferred to S1'. Graphically,

1.4
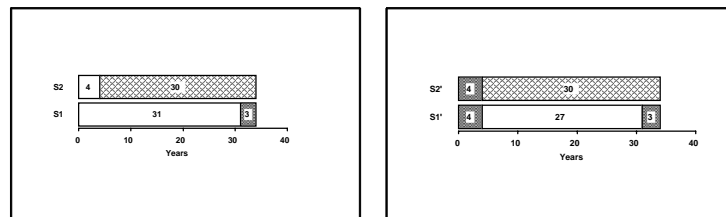
The aim of the second test is to check whether individuals fulfill *independence of the past with regard to the future.* To do so, we compare the answers to pairs of choices in which the alternative situations proposed are tied on the *last chronic period and length of life.* Tables 2, 4 and 6 correspond to this type of choice for young, Middle-aged and elderly groups, respectively.

1.7
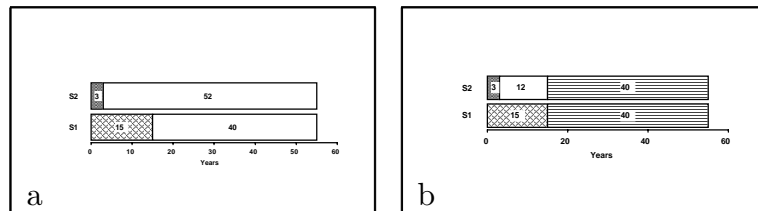
Note that, among all of these tests performed in a context of certainty, there are 15 of the type known as *replacement* tests (see [4]): the alternative health situations presented in any given test are not dominant, in the sense that neither of them is clearly preferred to the other.

Finally, we constructed three tests of *consistency,* described in Table 7 of *Appendix 3,* to analyze whether individuals behave consistently.

2.4. Procedure

With all individuals, we carried out the following procedure: The subjects read a brief description of each of the different health states presented in *Appendix 1*. It was emphasized in the instructions that only one of the four health states would be experienced during any given interval of time. Young people faced 20 choices each, whereas Middle-aged and elderly people faced 26 choices. By using these choices we performed 21 tests for every individual. There are, among the 21 tests, three tests of consistency, and 18 tests of independence. The pairs of questions corresponding to each of the independence tests were placed far from each other in the questionnaire. In this way, we avoided identical answers, made by inertia, in pairs of questions belonging to the same test. In facing every choice, the subjects were asked to imagine a particular illness or accidental injury, that could cause such health profiles. They were then asked about the health profile they would prefer in the case of suffering such illness or accidental injury. Each choice appeared on a separate sheet of paper, to discourage references to choices other than the current choice. At every choice, the inteviewers explained at least two alternative real situations underlying each health profile. Thus, it was quite likely that individuals could imagine and assess those situations. The real situations include some of the following health outcomes: cardio-vascular conditions, renal failure, headache, back pain, AIDS, rheumatism and accidental injuries. A typical example of the sort of questions presented appears in *Appendix 2*.

3. Results

3.1. Aggregate Analysis

We analyzed the choices made by each individual between both pairs of health situations in every independence test. From these choices, we obtained, at an aggregate level, the proportion of individuals who satisfy the independence property in each test. To do so, we performed a simple application of the "sign-matching tests" introduced in [7]. We computed an "independence score" for each test and for each subject. Since the questionnaire was only filled-in once, each test was coded as 1 if independence was satisfied by that subject and 0 if independence was violated.

The mean independence scores (and 95% confidence intervals) for the 18 independence tests for young, Middle-aged and elderly groups are shown in *Figures 1, 2* and *3,* respectively. All of the 18 mean values for the young and Middle-aged

groups were reliably higher than .5, indicating a significant satisfaction of Independence for all tests (in other words, Mutual Independence was fulfilled). Note, however, that for elderly people while the mean values in tests 1-6 are over .5, this is not so for tests 1.7-1.18. Additionally, if we concentrate on mean values for tests 1-6 across age, we cannot find any significant difference, whereas, for mean values of tests 7-18, there seems to be a certain tendency to diminish across age. Namely, *Independence of the future with regard to the past* is fulfilled similarly independently of age, while *Independence of the past with regard to the future* is less fulfilled as the ages increase.
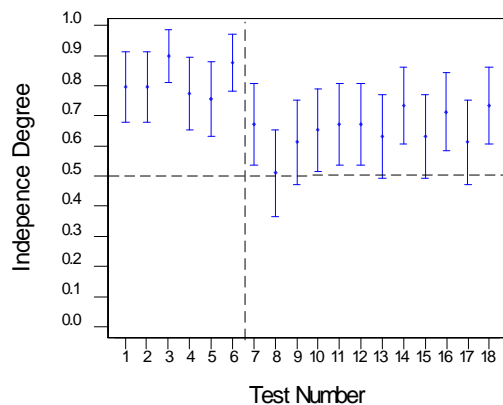
Figure 1
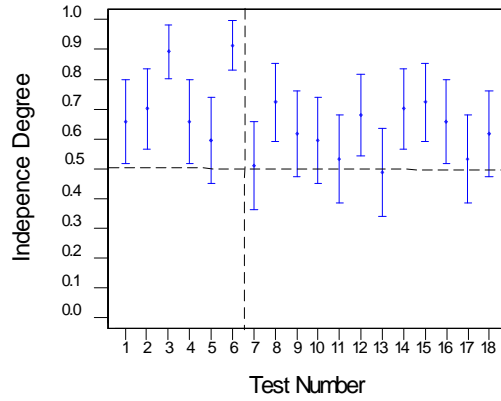
Figure 2
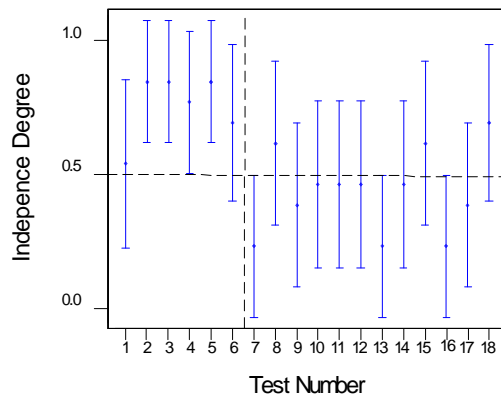
Figure 3

Previous results can be strenghtened if we analyze data from a different point of view. This is done in the following section.

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3.2. Individual Analysis

In this Section, we study the proportions of individuals satisfying one or both Independence properties, in most of the tests. We consider an agent's preferences as fulfilling these properties when the agent does not fulfil the property in only a reduced (fixed) number of tests. For the tests of the first type, we allowed a maximum of 2 failures, whereas, for those of the second type, we allowed 4 failures. Our results are summarized in Table 8: the first column [$IFRP \ (\leq 2)$] shows the percentage of total individuals interviewed (109) who satisfied independence of the future with respect to the past. The second column [$NIFRP \ (> 2)$] presents the percentage of total individuals interviewed who violate independence of the future with respect to the past. The first row [$IPRF \ (\leq 4)$] presents the percentage of total individuals interviewed who satisfy independence of the past with respect to the future. The second row [$NIPRF \ (> 4)$] gives the percentage of total individuals interviewed who violate independence of the past with respect to the future. The results are summarized in Table 8:

% total sample	$IFRP$ (≤ 2)	$NIFRP$ (> 2)	$Total$
$IPRF$ (≤ 4)	37.615	6.422	44.037
$NIPRF$ (> 4)	44.037	11.927	55.963
$Total$	81.652	18.348	100

<div align="center">Table 8</div>

The percentage of individuals satisfying independence of the future with regard to the past, is 81.652%, whereas the percentage of individuals satisfying independence of the past with regard to the future, is 44.037%. Both assumptions of Independence are satisfied by 37.615% of the individuals. Once again, this individual analysis indicates that the *property of independence of the Future with regard to the Past* is reliably better fulfilled than both the property of *independence of the Past with regard to Future* and that of *Mutual Independence.* Moreover, if we desaggregate the individual analysis for each group, we realize that, once again, the percentage of individuals fulfilling Independence of the Past with regard to the Future is much lower for the *Elderly* group than for the other groups: 23% for the *Elderly* group, 51% for the *Middle-aged* group, and 43% for the *Young* group. Nonetheless, the percentages of people fulfilling Independence of the Future with regard to the Past are very similar.

4. Final Remarks

Our results indicate that either at an aggregate level or at an individual level, *Independence of the future with regard to the past* is similarly fulfilled, independently of age, while *Independence of the past with regard to the future* seems less fulfilled as age increases. At an aggregate level, *Mutual Independence* is accurately satisfied, even though there is a higher level of satisfaction of *Independence of the future with regard to the past,* which is particularly significant within the Elderly group. Particularly, in this group, most of the tests of independence of the past with regard to the future fail, that is, they present mean values below .5. If we look at the individual analysis, the difference among the satisfaction degree for both independence properties increases for each group. The percentage of total individuals interviewed satisfying independence of the final periods with regard to the initial periods is 81.65%, whereas the percentage of total individuals satisfying independence of the initial periods with regard to the final periods is only 44.037%. Both Independence assumptions are satisfied by 37.615% of the individuals.

Our aggregate results in the *Young* and *Middle-aged* groups are similar to those in Treadwell, [4], who argues in favor of mutual independence, since all the mean values are reliably higher than 0.5. As he does not present an individual analysis and the individuals interviewed all belong to the *Young* group, we can not compare his results to ours, in this respect.

Our work has several differences with [4]. First, we consider some tests involving risk. The presence of risk does not seem to generate more violations of independence. On the contrary, independence actually seems to be better satisfied. Secondly, unlike Treadwell, we consider health profiles of different life-spans. His health profiles are all 30 years long; likewise, "chronic" periods in our health profiles are of variable duration. His are all of 10 years. Finally, we consider more health states (4 instead of 3), and ours are associated with a greater amount of illnesses, some of them associated with severe conditions.

As observed in [8], in some cases holistic causes can explain some violations of independence. In some of our tests we observed this peculiarity in situations related to infertility conditions.

The sequential effects observed by [9] and which contradict the QALY model, do not contradict the assumption of independence of the future with regard to the past. The model proposed in [6] allows for endogenous discount rates (and thus non-constant), consistent with their results. Similarly, this model does not contradict results in [10] which are also consistent with endogenous discount rates.

Something similar can be said about the results in [11]. They conclude that the evaluation of health profiles can not be performed by adding a weighted combination of assessed chronic health states to each interval. Their results, however, are compatible with our model since, in both cases, evaluations of complete health profiles are derived by assuming only independence of the future with regard to the past.

In summarizing then, we can conclude that the assumption of independence of the future with regard to the past seems to be more appropriate than the assumption of mutual independence. The empirical results obtained in this study, together with those obtained by other authors, are more consistent with the *semiseparable* model than with the QALY model. Even though, the semiseparable model seems to represent individual preferences better, it is far more complicated to estimate. We, therefore, face a trade-off between simplicity and accuracy in the representation of individual preferences. In fact, the formulation of an estimation method for the semiseparable model is still an open task.

Some alternative measures, like the HYES in [12] for instance, have been also

strongly criticized in [1] and [13].

References

[1] Bleichrodt, H. QALYs and HYEs: Under what conditions are they equivalents? J Health Econ 1995**; 14**: 17-37**.**

[2] Fishburn P. C. Independence in utility theory with whole product sets. Oper Res 1965**; 13**: 28-45.

[3] Fishburn P. C. Utility theory for decision making. John Wiley, New York, 1970**.**

[4] Treadwell J.R. Tests of preferential independence in the QALY model. Med Dec Making 1998**; 18**: 418-428.

[5] Loomes, G. & McKenzie, L. The use of QALYs in Health Care Decision Making. Soc Sci Med 1989; **28**(4): 299-308.

[6] Guerrero, A.M. & Herrero, C. Generalizing QALYs with a semi-separable utility function, Working paper WP-AD 99-20: 1999a. Universidad de Alicante.

[7] Miyamoto JM, Lundell JW & Tu S. Sign matching tests for ordinal independence in paired comparison and rating data. Working paper 1997**.** Department of Psycology, University of Washington, Seattle, Washington.

[8] Hall J., Gerard K., Salkeld G., & Richardson J.A. A cost utility analysis of mammography screening in Australia. Soc Sci Med 1992; **34**: 993-1004.

[9] Krabbe PFM & Bonsel GJ. Sequence effects, health profiles, and the QALY model. Med Dec Making 1998*;* **18**: 178-186.

[10] Richardson J., Hall J. & Salkeld G. The measurement of utility in multiphase health states. Int J Tech Assess Health Care 1996*;* **12**: 151-162.

[11] Kuppermann, M., Shiboski, S, Feeny, D., Elkin, E.P. & Washington, AE. Can preference scores for discrete states be used to derive preference scores for an entire path of events? An application to prenatal diagnosis. Med Dec Making 1997*;* **17**: 152-159.

[12] Mehrez, A. & Gafni, A. Quality -adjusted life years, utility theory, and healthy-years equivalents. Med Dec Making 1989; **10**: 142-49.

[13] Wakker, P. A criticism of healthy-years equivalents. Med Dec Making 1996; **16**: 207-214.

APPENDIX 1

Health State Descriptions

GENERAL DAILY ACTIVITIES

- Able to perform all tasks at home and/or at work **without problems.**
- **Not** able to perform **many** tasks at home and/or work.
- **Not** able to perform **any** tasks at home and/or work.

PAIN AND/OR OTHER COMPLAINTS

- **No** pain and/or other complaints.
- **Often** light to moderate pain and/or other complaints.
- **Often** moderate to severe pain and/or other complaints.

We presented four health states to the subjects in our study. They are described by combining different levels of the two previous attributes. The health states are called **A**,**B**,**C**,**D**, and they are chosen so that

$$\mathbf{A} \succ \mathbf{B} \succ \mathbf{C} \succ \mathbf{D}$$

We define each health state as follows:

A

Able to perform all tasks at home and/or at work **without problems.**
No pain and/or other complaints.

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B

Able to perform all tasks at home and/or at work **without problems.**
Often light to moderate pain and/or other complaints.

C

Not able to perform **many** tasks at home and/or work.
Often light to moderate pain and/or other complaints.

D

Not able to perform **any** tasks at home and/or work.
Often moderate to severe pain and/or other complaints.

APPENDIX 2

Description of a question linked to a Hypothetical Condition

You have been diagnosed as having a certain gene. Consequently, after 4 years, you will develop a particular illness. In the mean time, however, you will not suffer from any symptoms. There are two different treatments, to be applied in 4 years time.

If you choose the first treatment, (S1) you will live for 15 years more in health state B. After that 15 year-period, you will die.

With the alternative treatment, (S2) and provided it is successful (likelihood 95%), you will live for 26 years more in an excellent health state (A) following which you will die. If the treatment fails (likelihood 5%), you will live in a severe state (D) for 10 years, and then you will die.

What treatment would you prefer? The graph describes the situations you will face under the alternative treatments. Tick either S1 (if you prefer the first treatment), S2, if you prefer the second treatment) or I (if you are indifferent to the choice of treatment).
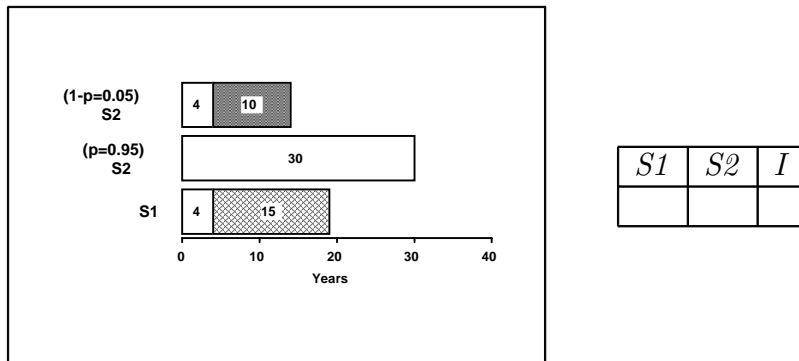
APPENDIX 3
Description of tests

Young group

Tests of Independence of the Future with regard to the Past (Tests 1.1-1.6)

Table 1

Tests of Independence of the Past with regard to the Future (Tests 1.7-1.18)

Table 2

Middle-Aged Group
Tests of Independence of the Future with regard to the Past (Tests 2.1-2.6)

Test 2.1

(90%) S2 | 5 | 20 | 5
(10%) S2 | 5 | 25
S1 | 5 | 25

(90%) S2' | 5 | 20 | 5
(10%) S2' | 30
S1' | 5 | 25

Test 2.2

(90%) S2 | 5 | 20 | 5
(10%) S2 | 5 | 20
S1 | 5 | 10 | 10

(90%) S2' | 5 | 20 | 5
(10%) S2' | 25
S1' | 5 | 10 | 10

Test 2.3

(90%) S2 | 4 | 21
(10%) S2 | 10
S1 | 4 | 14 | 2

(90%) S2' | 4 | 21
(10%) S2' | 4 | 6
S1' | 18 | 2

Test 2.4

S2 | 24 | 6
S1 | 5 | 25

S2' | 5 | 19 | 6
S1' | 5 | 25

Test 2.5

S2 | 5 | 6 | 19
S1 | 5 | 25

S2' | 11 | 19
S1' | 5 | 25

Test 2.6

S2 | 6 | 16 | 8
S1 | 6 | 24

S2' | 6 | 16 | 8
S1' | 6 | 24

Table 3

Tests of Independence of the Past with regard to the Future (Tests 2.7-2.18)
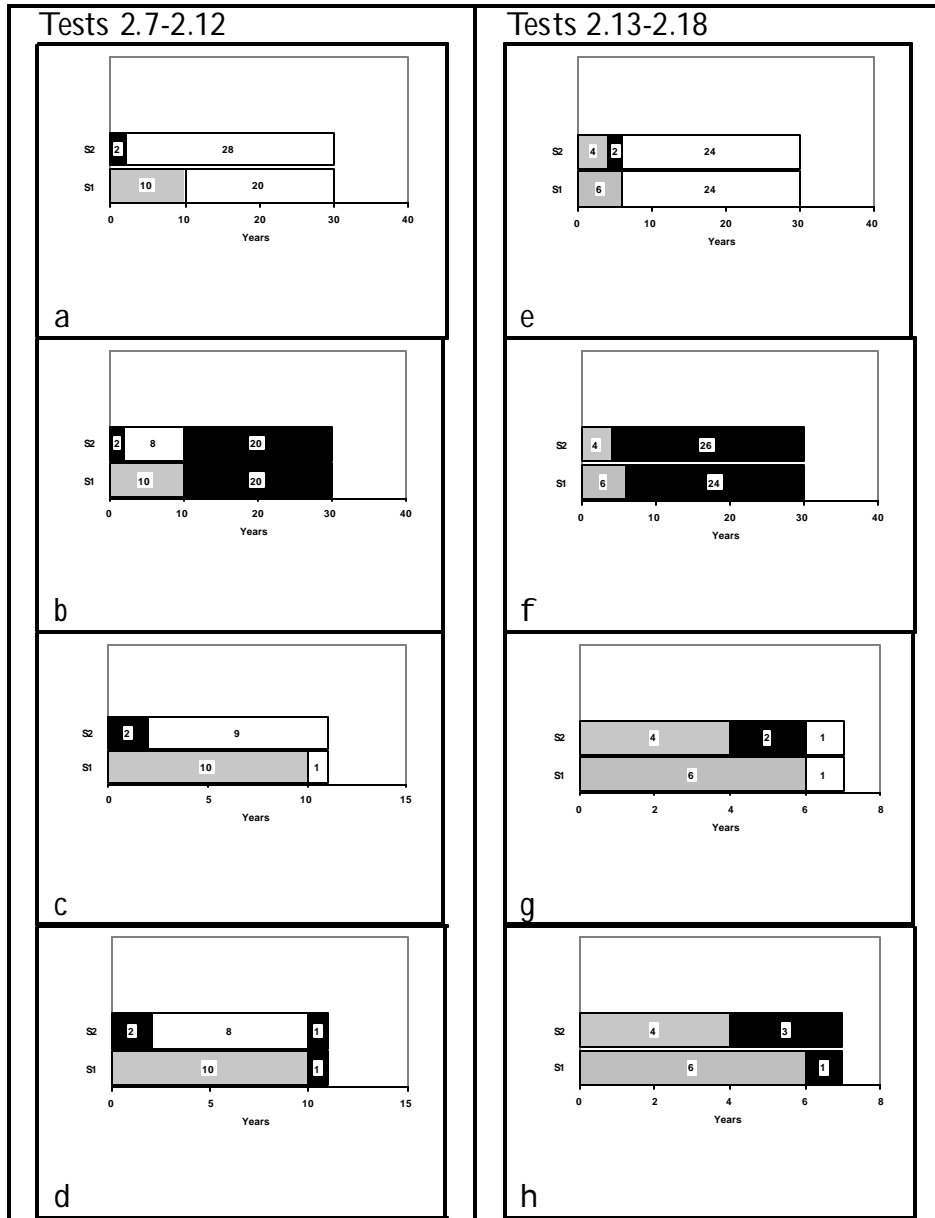
Table 4

Elderly Group
Tests of Independence of the Future with regard to the Past (Tests 3.1-3.6)

Test 3.1

(90%) S2: 2 | 10 | 3
(10%) S2: 2 | 13
S1: 2 | 13

(90%) S2': 2 | 10 | 3
(10%) S2': 2 | 15
S1': 2 | 13

Test 3.2

(90%) S2: 2 | 10 | 3
(10%) S2: 2 | 11
S1: 2 | 5 | 6

(90%) S2': 2 | 10 | 3
(10%) S2': 13
S1': 2 | 5 | 6

Test 3.3

(90%) S2: 2 | 11
(10%) S2: 5
S1: 2 | 7 | 1

(90%) S2': 2 | 11
(10%) S2': 2 | 3
S1': 9 | 1

Test 3.4

S2: 12 | 3
S1: 5 | 10

S2': 5 | 7 | 3
S1': 5 | 10

Test 3.5

S2: 2 | 3 | 10
S1: 2 | 13

S2': 5 | 10
S1': 2 | 13

Test 3.6

S2: 3 | 8 | 4
S1: 3 | 12

S2': 3 | 8 | 4
S1': 3 | 12

Table 5

3
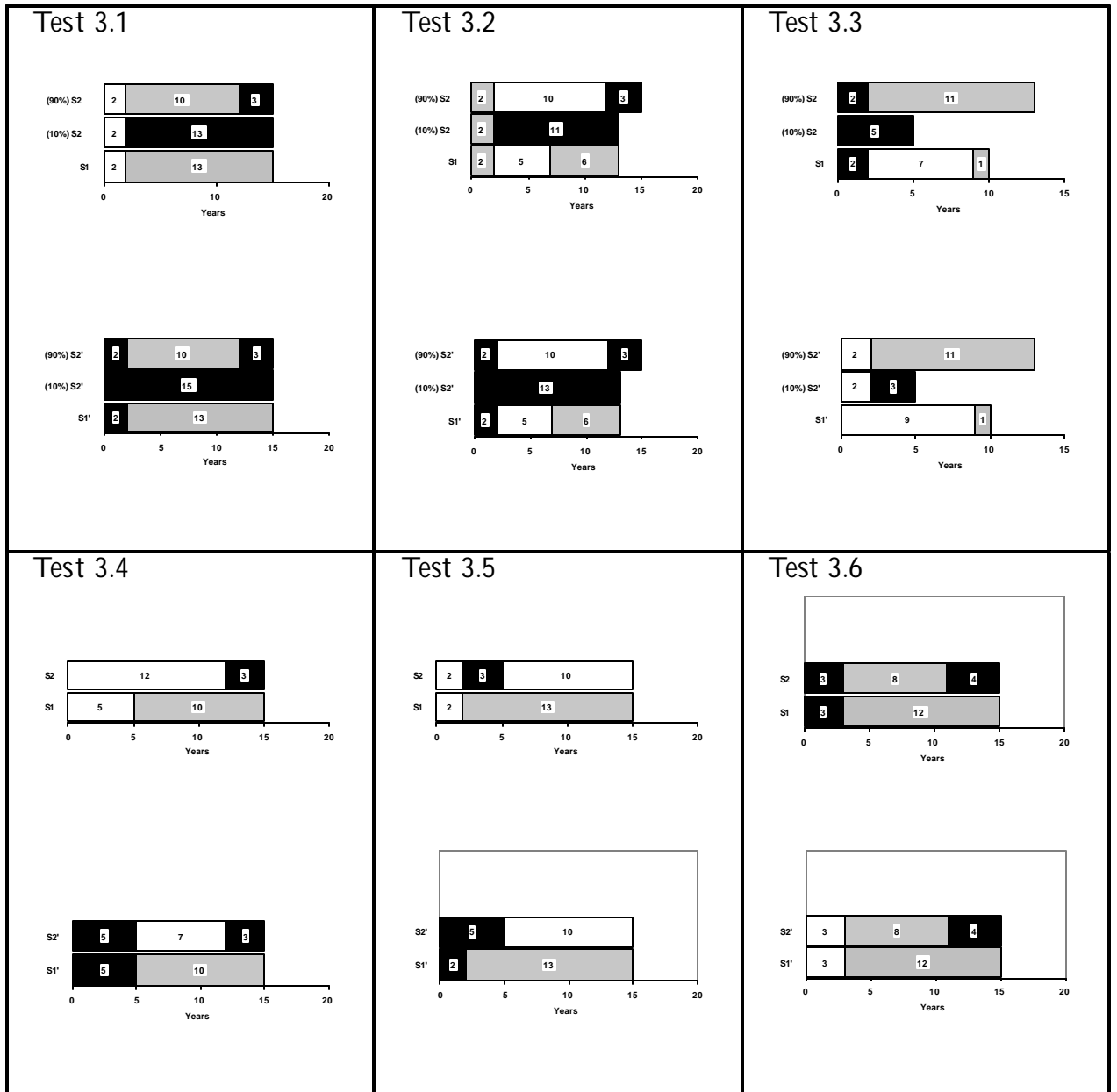
Tests of Independence of the Past with regard to the Future (Tests 3.7-3.18)

Tests 3.7-3.12

Tests 3.13-3.18

a

S2 1 14

S1 5 10

Years

b

S2 1 4 10

S1 5 10

Years

c

S2 1 5

S1 5 1

Years

d

S2 1 4 1

S1 5 1

Years

e

S2 2 1 12

S1 3 12

Years

f

S2 2 13

S1 3 12

Years

g

S2 2 1 3

S1 3 3

Years

h

S2 2 4

S1 3 3

Years

Table 6

4

C1	C2	C3
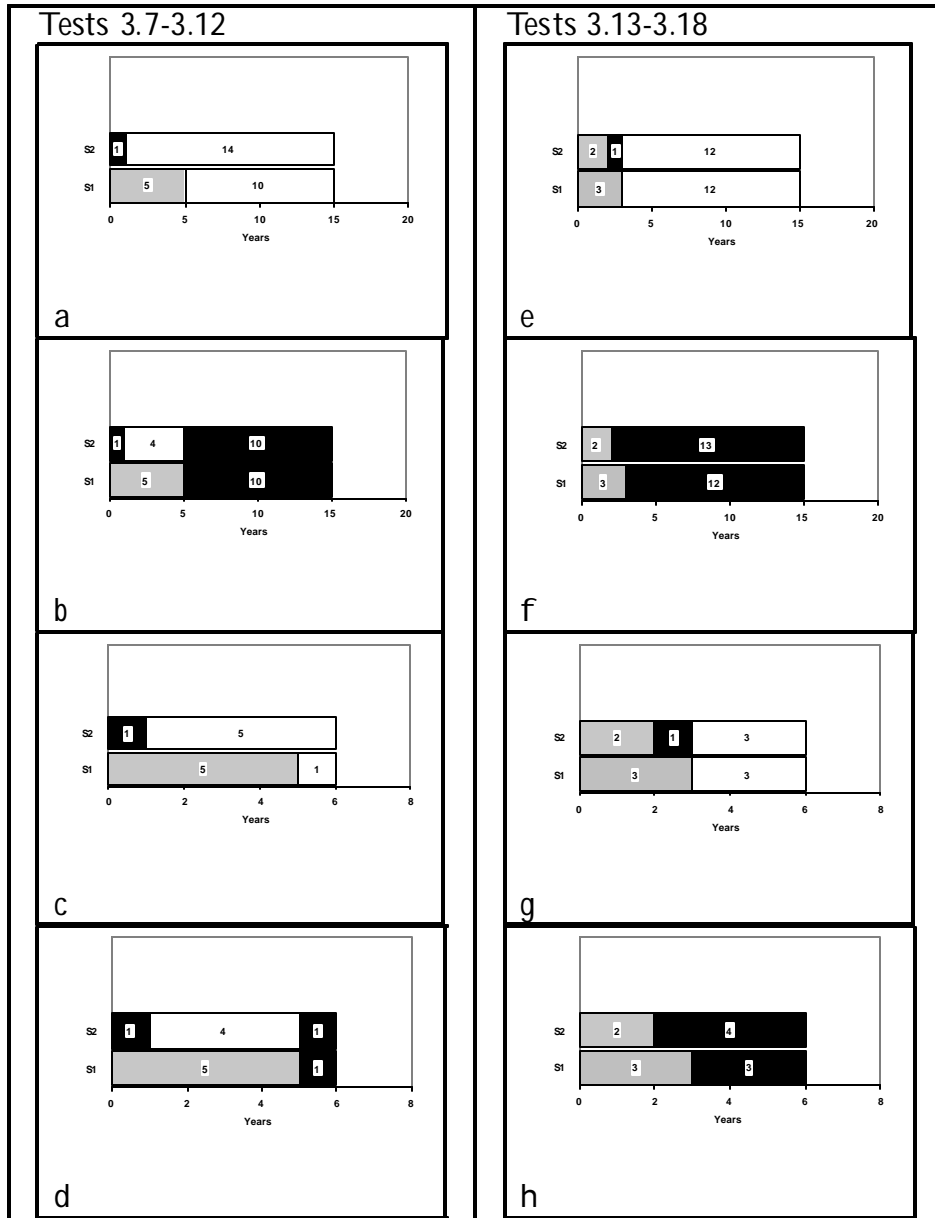
Table 7

APPENDIX 4
Independence Results

Young group

Results of Independence of the Future with regard to the Past (Tests 1.1-1.6)

<table>
<tr><td colspan="4">1.1</td><td colspan="4">1.2</td></tr>
<tr><td></td><td>*S1*</td><td>*S2*</td><td>*I*</td><td></td><td>*S1*</td><td>*S2*</td><td>*I*</td></tr>
<tr><td>*S1'*</td><td>8</td><td>2</td><td></td><td>*S1'*</td><td>7</td><td>1</td><td></td></tr>
<tr><td>*S2'*</td><td>7</td><td>31</td><td></td><td>*S2'*</td><td>7</td><td>32</td><td></td></tr>
<tr><td>*I'*</td><td></td><td>1</td><td></td><td>*I'*</td><td>1</td><td>1</td><td></td></tr>
<tr><td colspan="4">1.3</td><td colspan="4">1.4</td></tr>
<tr><td></td><td>*S1*</td><td>*S2*</td><td>*I*</td><td></td><td>*S1*</td><td>*S2*</td><td>*I*</td></tr>
<tr><td>*S1'*</td><td>7</td><td>1</td><td></td><td>*S1'*</td><td>21</td><td>8</td><td></td></tr>
<tr><td>*S2'*</td><td>3</td><td>36</td><td></td><td>*S2'*</td><td>3</td><td>16</td><td></td></tr>
<tr><td>*I'*</td><td></td><td>1</td><td>1</td><td>*I'*</td><td></td><td></td><td>1</td></tr>
<tr><td colspan="4">1.5</td><td colspan="4">1.6</td></tr>
<tr><td></td><td>*S1*</td><td>*S2*</td><td>*I*</td><td></td><td>*S1*</td><td>*S2*</td><td>*I*</td></tr>
<tr><td>*S1'*</td><td>20</td><td>7</td><td></td><td>*S1'*</td><td>25</td><td>2</td><td></td></tr>
<tr><td>*S2'*</td><td>4</td><td>17</td><td>1</td><td>*S2'*</td><td>3</td><td>18</td><td>1</td></tr>
<tr><td>*I'*</td><td></td><td></td><td></td><td>*I'*</td><td></td><td></td><td></td></tr>
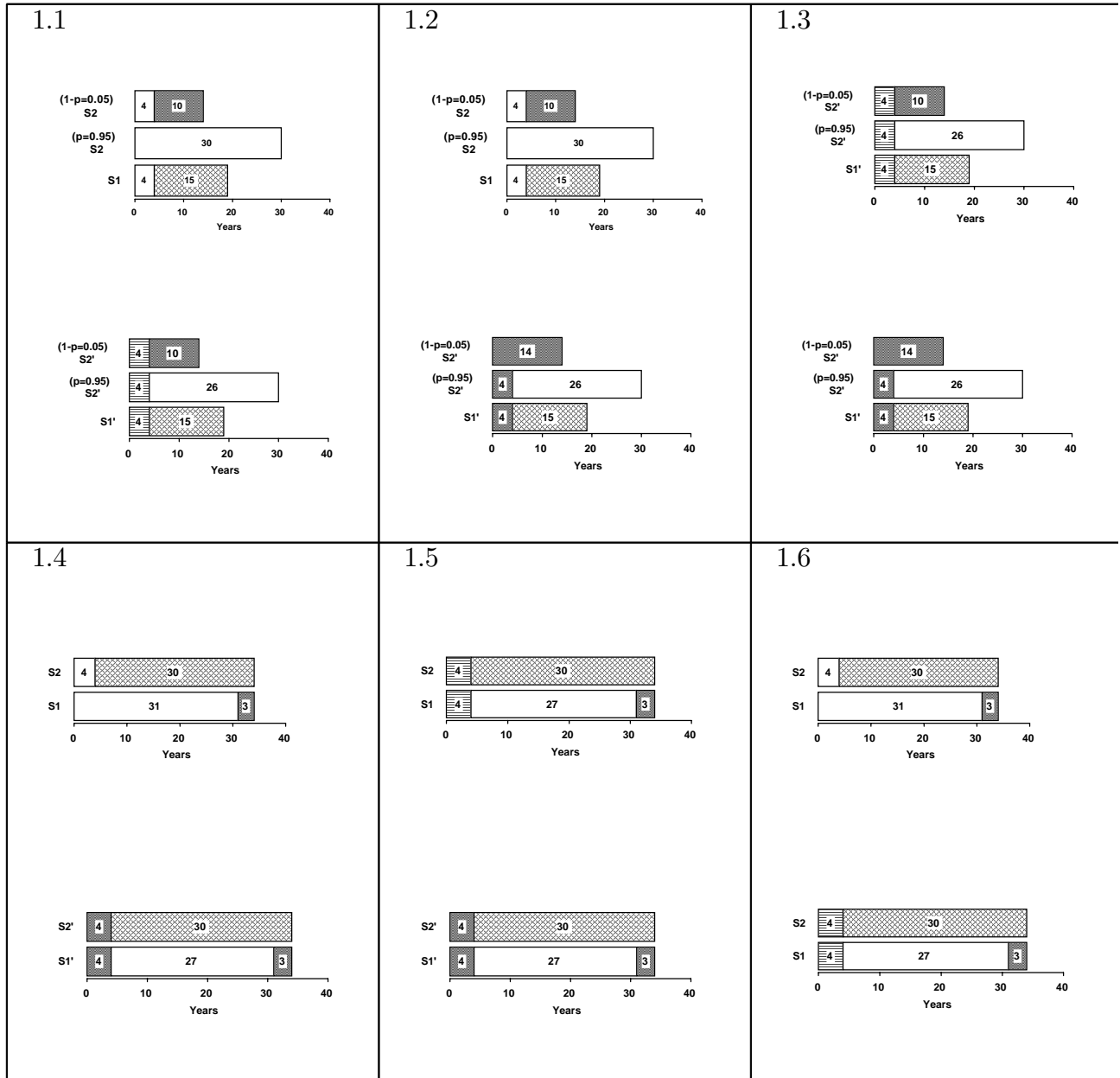</table>

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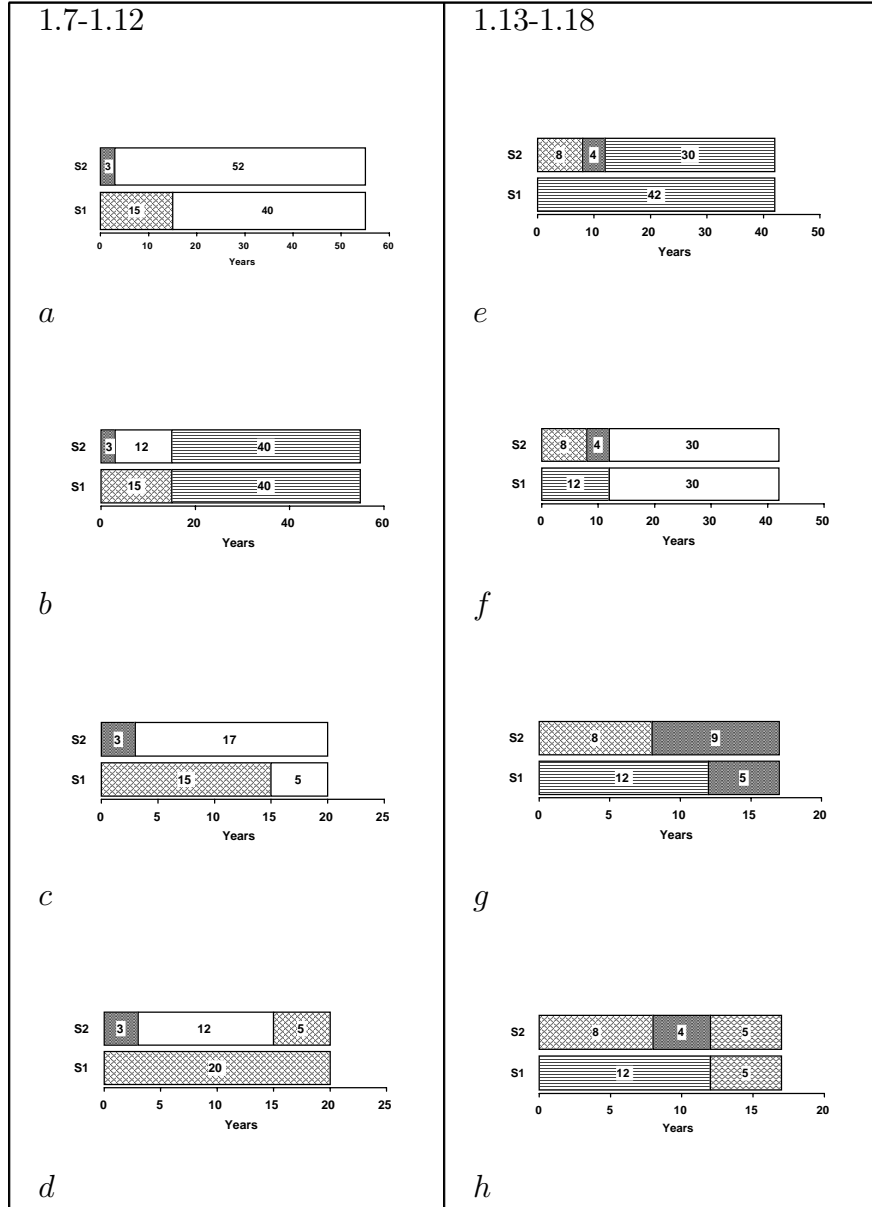*Results of Independence of the Past with regard to the Future (Tests 1.7-1.18)*

Tests 1.7-1.12

1.7	a *S1*	a *S2*	a *I*
b *S1*	**20**	**6**	
b *S2*	**8**	**13**	**1**
b *I*	**1**		

1.8	c *S1*	c *S2*	c *I*
d *S1*	**10**	**13**	**3**
d *S2*	**7**	**15**	**1**
d *I*			

1.9	a *S1*	a *S2*	a *I*
c *S1*	**14**	**3**	
c *S2*	**11**	**16**	**1**
c *I*	**4**		

1.10	a *S1*	a *S2*	a *I*
d *S1*	**20**	**7**	
d *S2*	**9**	**12**	**1**
d *I*			

1.11	c *S1*	c *S2*	c *I*
b *S1*	**14**	**10**	**2**
b *S2*	**3**	**18**	**1**
b *I*			**1**

1.12	d *S1*	d *S2*	d *I*
b *S1*	**18**	**8**	
b *S2*	**7**	**15**	
b *I*	**1**		

Tests 1.13-1.18

1.13	e *S1*	e *S2*	e *I*
f *S1*	**12**	**5**	**2**
f *S2*	**8**	**16**	**1**
f *I*	**1**	**1**	**3**

1.14	h *S1*	h *S2*	h *I*
g *S1*	**10**	**2**	
g *S2*	**8**	**23**	
g *I*	**2**	**1**	**3**

1.15	h *S1*	h *S2*	h *I*
e *S1*	**13**	**8**	
e *S2*	**5**	**16**	**1**
e *I*	**2**	**2**	**2**

1.16	h *S1*	h *S2*	h *I*
f *S1*	**15**	**5**	
f *S2*	**5**	**18**	**1**
f *I*		**3**	**2**

1.17	e *S1*	e *S2*	e *I*
g *S1*	**9**	**2**	**1**
g *S2*	**9**	**19**	**3**
g *I*	**3**	**1**	**2**

1.18	g *S1*	g *S2*	g *I*
f *S1*	**11**	**7**	**2**
f *S2*	**1**	**22**	**1**
f *I*		**2**	**3**

Middle-aged group

Results of Independence of the Future with regard to the Past (Test 2.1-2.6)

<table>
<tr><td colspan="4">2.1</td><td colspan="4">2.2</td></tr>
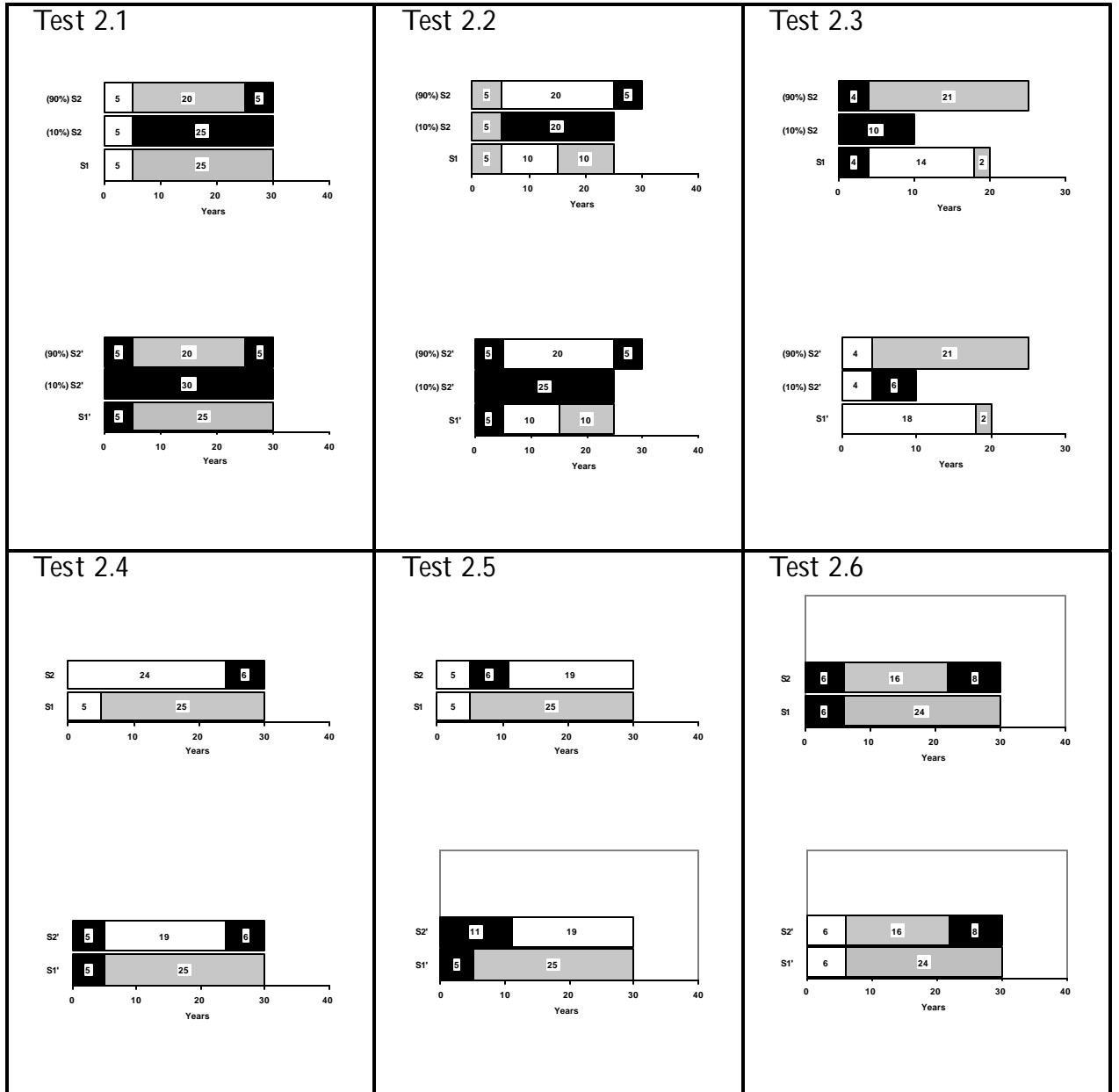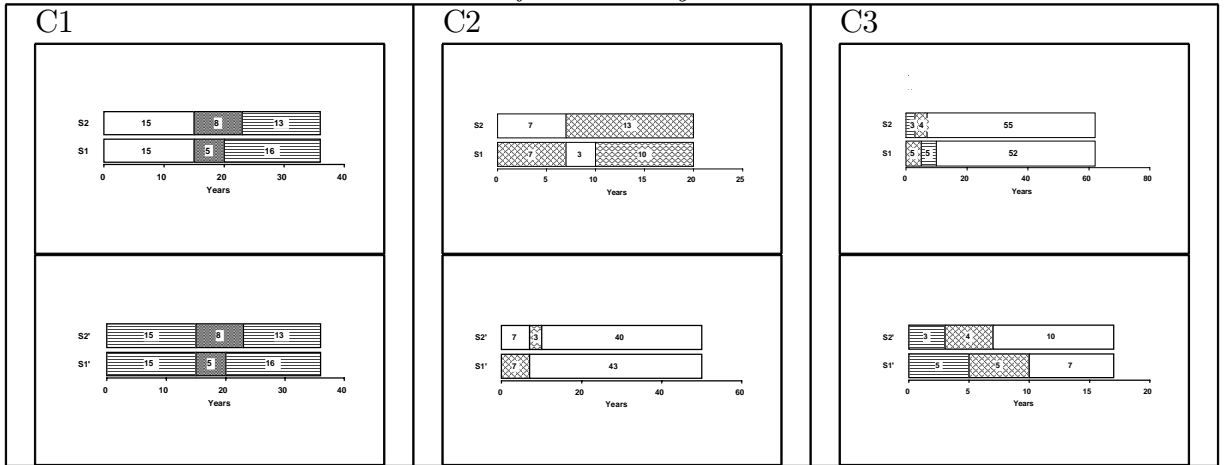<tr><td></td><td>S1</td><td>S2</td><td>I</td><td></td><td>S1</td><td>S2</td><td>I</td></tr>
<tr><td>S1'</td><td>15</td><td>5</td><td>0</td><td>S1'</td><td>5</td><td>5</td><td>0</td></tr>
<tr><td>S2'</td><td>8</td><td>15</td><td>1</td><td>S2'</td><td>7</td><td>28</td><td>0</td></tr>
<tr><td>I'</td><td>1</td><td>1</td><td>1</td><td>I'</td><td>1</td><td>1</td><td>0</td></tr>
<tr><td colspan="4">2.3</td><td colspan="4">2.4</td></tr>
<tr><td></td><td>S1</td><td>S2</td><td>I</td><td></td><td>S1</td><td>S2</td><td>I</td></tr>
<tr><td>S1'</td><td>14</td><td>2</td><td>0</td><td>S1'</td><td>2</td><td>6</td><td>0</td></tr>
<tr><td>S2'</td><td>3</td><td>28</td><td>0</td><td>S2'</td><td>9</td><td>31</td><td>0</td></tr>
<tr><td>I'</td><td>0</td><td>0</td><td>0</td><td>I'</td><td>1</td><td>0</td><td>0</td></tr>
<tr><td colspan="4">2.5</td><td colspan="4">2.6</td></tr>
<tr><td></td><td>S1</td><td>S2</td><td>I</td><td></td><td>S1</td><td>S2</td><td>I</td></tr>
<tr><td>S1'</td><td>8</td><td>8</td><td>0</td><td>S1'</td><td>9</td><td>2</td><td>0</td></tr>
<tr><td>S2'</td><td>10</td><td>20</td><td>0</td><td>S2'</td><td>1</td><td>30</td><td>0</td></tr>
<tr><td>I'</td><td>0</td><td>1</td><td>0</td><td>I'</td><td>0</td><td>1</td><td>4</td></tr>
</table>

$2.7 - 2.12$

2.7	aS1	aS2	aI
bS1	7	7	0
bS2	13	17	0
bI	0	3	0

2.8	cS1	cS2	cI
dS1	17	4	0
dS2	9	17	0
dI	0	0	0

2.9	aS1	aS2	aI
cS1	14	12	0
cS2	6	15	0
cI	0	0	0

2.10	aS1	aS2	aI
dS1	11	10	0
dS2	9	17	0
dI	0	0	0

2.11	bS1	bS2	14bI
cS1	10	18	0
cS2	4	15	3
cI	0	0	0

2.12	bS1	bS2	bI
dS1	11	10	0
dS2	2	21	3
dI	0	0	0

$2.13 - 2.18$

2.13	eS1	eS2	eI
fS1	7	13	0
fS2	2	15	0
fI	3	6	1

2.14	gS1	gS2	gI
hS1	12	9	1
hS2	1	19	1
hI	0	2	2

2.15	eS1	eS2	eI
gS1	8	6	0
gS2	4	25	0
gI	0	3	1

2.16	eS1	eS2	eI
hS1	11	11	0
hS2	0	20	1
hI	1	3	0

2.17	fS1	fS2	fI
gS1	7	2	4
gS2	12	15	3
gI	1	0	3

2.18	fS1	fS2	fI
hS1	14	5	3
hS2	5	12	4
hI	1	0	3

Elderly group

Results of Independence of the Future with regard to the Past (Tests 3.1-3.6)

3.1

	S1	S2	I
S1'	0	0	1
S2'	2	5	0
I'	2	1	2

3.2

	S1	S2	I
S1'	2	0	0
S2'	0	9	0
I'	0	2	0

3.3

	S1	S2	I
S1'	3	0	1
S2'	0	8	1
I'	0	0	0

3.4

	S1	S2	I
S1'	2	0	0
S2'	3	8	0
I'	0	0	0

3.5

	S1	S2	I
S1'	3	1	0
S2'	1	8	0
I'	0	0	0

3.6

	S1	S2	I
S1'	0	0	0
S2'	0	8	2
I'	1	1	1

Results of Independence of the Past with regard to the Future (Test 3.7-3.18)

3.7 – 3.12				3.13 – 3.18			

3.7	**aS1**	**aS2**	**aI**
bS1	2	2	0
bS2	3	1	0
bI	4	1	0

3.13	**eS1**	**eS2**	**eI**
fS1	0	1	0
fS2	3	3	0
fI	1	5	0

3.8	**cS1**	**cS2**	**cI**
dS1	2	2	0
dS2	3	6	0
dI	0	0	0

3.14	**gS1**	**gS2**	**gI**
hS1	0	2	0
hS2	1	5	0
hI	0	1	0

3.9	**aS1**	**aS2**	**aI**
cS1	3	2	0
cS2	6	2	0
cI	0	0	0

3.15	**eS1**	**eS2**	**eI**
gS1	1	1	0
gS2	3	7	0
gI	0	1	0

3.10	**aS1**	**aS2**	**aI**
dS1	3	1	0
dS2	6	3	0
dI	0	0	0

3.16	**eS1**	**eS2**	**eI**
hS1	11	2	0
hS2	3	3	0
hI	1	4	0

3.11	**bP1**	**bP2**	**14bI**
cP1	3	1	1
cP2	1	3	4
cI	0	0	0

3.17	**fP1**	**fP2**	**fI**
gP1	0	2	1
gP2	1	4	4
gI	0	0	1

3.12	**bS1**	**bS2**	**bI**
dS1	3	1	0
dS2	1	3	5
dI	0	0	0

3.18	**fS1**	**fS2**	**fI**
hS1	1	1	0
hS2	0	4	2
hI	0	1	4