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STEREOTYPES INHIBITION IN SYLLOGISTIC REASONING CHANGES RELATED TO AGE AND TIME MEASUREMENT REPETITION DURING STUDY

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Summary. The aim of this study was to verify the hypothesis saying that older people on average achieve a lower level of performance than younger at solving syllogisms which contain stereotypical knowledge about aging, and to decide whether the nature of the changes taking place during the test (under the influence of exercise) corresponds to a greater extent to the assumptions of the disuse hypothesis (greater gradient of improvement in elderly subjects), or to the assumptions about age-related decline of developmental plasticity (gradient greater of improvement in the young). Generalizing the empirical findings, we can say that, compared with younger people a slowdown in the syllogistic reasoning does not characterize cognitive functioning of people in late adulthood. They can solve syllogisms just as quickly as younger subjects. However, they respond more slowly when the tasks are subject to stereotypical content and less accurately when the conclusions of syllogisms are false. The analysis of differences and patterns of changes in the speed and correctness of responses during the test of syllogistic reasoning in the age groups leads to ambiguous statements about the expected influence of the age of life in the improvement of performance of tasks under the influence of measurement repetition (practice). We came to the conclusion that in the search for a model of study, which separates from each other the effects of age (macro-developmental changes) and repetition of measurements during the test (micro-developmental changes) probably more useful is a flowchart of tasks' exposure and comparison of the changes/differences related to age and measurement time. Thus, such studies require an increase of the number of measurements/tasks during the test.
Key words: syllogistic reasoning, age stereotypes, dual-reasoning theory, cognitive ageing

Introduction

Dual-process theories. According to dual-process theories, human reasoning can be explained by the interaction of two different systems: (1) based on prior knowledge and beliefs (belief-based), the operation of which is characterized by

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unconscious, quick and automatic processes, and (2) based on the principles of logic (logic-based), the operation of which is characterized by processes of consciousness, slow and rational (de Neys, 2006; Evans, 2008; Overton, Ricco, 2010). These systems sometimes lead to conflicting conclusions: one thing results from our knowledge and beliefs, and another from logical reasoning.

A prevailing view is that such conflict situations/tasks require more attention, engage analytical processes and generally require more cognitive control in inhibition of inappropriate cognitive attitudes and generally require more time needed to verify the reliability of judgments arising out of knowledge and belief.

Components of cognitive change. The measurement of change is not possible in isolation from the passage of time. However, for a long time we have known that at the time of the study it is not so much a function of time, but rather a function of the multiple impacts (related to experience, maturation, and method of measurement), which are difficult to separate from each other, which threatens the integrity of the measurement. In the literature we find different suggestions how to isolate these effects in the study of change, such as the effects of cohort and repetition of measurement (Schaie, 1965), related and not related to the prior experience of taking the test (Baltes, Reese, Nesselroade, 1977), and dependent on and independent of retest interval (Salthouse, 2011), and the like. All these attempts increase the accuracy of measurement of the longitudinal effects and thereby assessment of the dynamics of changes in the functioning and development of man.

In terms of whole-relational an approach can be offered that complements efforts undertaken in this field so far, which draws attention to the additional problem of reliability in the evaluation of developmental change. In the approach proposed by us one can distinguish two main components of change: (a) macroscopic, when researchers focus attention on long-term changes, including longer periods of life and more holistic transformations in the not very well-defined situations, or sometimes in "the situation in general", and (b) microscopic, when researchers observe short-term changes and rather elementary functions in well-defined circumstances, such as experimental conditions. Macroscopic changes are usually associated with the age of subjects (or biological events and/or environmental, related to age). Whereas microscopic changes are related to the time of measurement (or direct experience during the test). This model (see Trempała, 2011), grew out of developmental research on the origins of mental life and assumes that the macro- and micro-developmental changes in the functioning of man are related to each other, but cannot be reduced to one another: just like in the physical world not all macro-processes can be described in terms of micro-processes and vice versa. The emergence of short-term elementary changes during the measurement of the interesting function and more long-term trajectories of change are not subject to the same rules: long-term changes do not rely on a simple summation of the short-term changes observed during the test, and vice versa, long-term trajectories of change cannot always be broken down into elementary. There is a need to identify these components in a single research study, which may prove to be valuable for a better understanding of the relationship between micro-and macro-changes in the func-

tioning and development of man. The study presented in this paper is an attempt to verify some of the assumptions of the model outlined above.

Changes in the reasoning of adults. In the literature it is often argued that the level of reasoning in tasks requiring inhibition of inappropriate cognitive attitudes (including stereotypes) increases from childhood to early adulthood and then shows a decrease with age in adults (see review in: de Neys, 2006; Evans 2008, as well as: de Neys, von Gelder, 2009). This pattern of development is usually explained by changes in the frontal lobes (Aron, Poldrack, 2005; Davidson, Zaks, Williams, 2007).

The correctness of this explanation is confirmed by the results of studies on the involvement of brain structures while performing tasks that require logical reasoning, in which there is a mismatch between a logical conclusion and conclusion based on the beliefs (*inhibition belief trials*). In case of correct answers there is an increased activity in the right lateral prefrontal cortex, whereas in case of incorrect answers (i.e. under the influence of beliefs) – ventral medial prefrontal cortex (Goel et al., 2000; Goel, Dolan, 2003). Also other neuroimaging studies indicate the involvement of the dorsolateral prefrontal cortex during logical reasoning and prefrontal ventromedial cortex for intuitive answer or "guessing" (e.g. Elliott, Rees, Dolan, 1999; Houde et al., 2000; Knauf et al., 2002). This allows one to predict that in consequence of atrophic changes in the frontal area accompanying the process of aging, elderly people will present lower than the young level of performance of tasks requiring logical reasoning and inhibition of inappropriate attitudes.

Most developmental studies on inhibition focus on macroscopic changes, i.e. the average tendencies related to the age of subjects, usually on the average differences in the level of performance of specified tasks in different age groups. However, studies on the microscopic changes during the test, related to the repetition of the measurement (and thus the practice of what is measured), suggest that individual differences in formation of changes (e.g. the extent of performance improvement) are dependent not so much on the age but rather on the initial level of "training" and "opportunity" to carry out the tasks of a given kind during the measurement. Taking into account the disuse hypothesis (see Salthouse, 1994), it is believed that the lower the initial level and the more opportunities to exercise, the greater is the gradient of improvement (see Charnees, 1985; Salthouse, 1992; Lamson, Rogers, 2008).

From this point of view, young and older people, whose initial level of "training" in solving syllogisms requiring inhibition of stereotypical cognitive attitudes is different, can also vary in the degree of improvement of performance of the tasks in subsequent attempts. Theoretically, one can imagine that as a result of "disuse" of certain cognitive competencies, the first in the series of tasks used in the study, the elderly will solve much worse than the younger ones, but – according to the findings of the theory of learning – the last of them at a similar level, thanks to the "opportunity" for "practicing" the tasks during the study.

On the other hand, comparison of age groups in terms of improving the level of performance of the tasks as the result of a growing practice, carried out in the paradigm of testing boundaries, indicate that interventions in the form of train-

ing bring more positive results in young people (Baltes, 1987; Kliegl, Smith, Baltes, 1989, 1990; Baltes, Kliegl, 1992; Hertzog, Cooper, Fisk, 1996). This pattern is interpreted as a proof of the age-related reduction of neuronal and behavioral plasticity – diminishing developmental reserves (Baltes, 1997; Brehmer et al., 2007; Hertzog et al., 2008; Stine-Morrow, Basak, 2011). Taking this perspective it can be expected that the age-related initial differences in the level of performance will increase during the study.

Regardless of the predictions arising from the disuse hypothesis "diminishing developmental plasticity", comparing the average results in the age groups of the series of measurements ignores micro-developmental effects occurring during the study, which are superimposed on the macro-developmental effects. As a result, the macroscopic view of the difference between younger and older people can lead to artifacts. Measurement error in such cases consists in not separating the effects of the developmental change, which we study, from not only (a) the effects of inter-generational differences, e.g. those related to experience (skill, knowledge and beliefs) of people of different ages, but also (b) the effects of measurement repetition associated with direct experience (learning) during measurement.

In a study on the development of deductive reasoning we encounter additional issues that should be considered in studies of inhibition of stereotypes. Firstly, it turns out that children, who do not yet have stereotypic knowledge, solve syllogisms containing stereotypes just as good or even better than adults (de Neys, Vanderputte, 2011). This means that "knowing less" does not always mean "worse reasoning". It is therefore possible that young people who, as it turns out, sometimes use stereotypes less frequently than older ones (e.g. in opinions on aging, see. Trempała, Zając-Lamparska, 2007; Zając-Lamparska, 2008a, 2008b), will be better at solving syllogisms containing stereotypical content. Secondly, it has long been known that, contrary to the findings by J. Piaget, even young children are capable of syllogistic reasoning: to solve simple syllogisms (Bara, Bucciarelli, Johnson-Laird, 1995). This means that the differences between young and old in the application of syllogisms (in the level of performance and degree of correctness), will depend not only on the contents, but also on their formal properties (e.g. consistency of premises and/or conclusions), and the related operational requirements (e.g. involving memory and analytical processes). Therefore, in the present study of changes related to age and time of measurement, we control not only the contents of the tasks but also of their formal properties.

The aim of the study. The aim of this study was to verify the hypothesis saying that older people on average achieve a lower level of performance than younger at solving syllogisms which contain stereotypical knowledge about aging, and to decide whether the nature of the changes taking place during the test (under the influence of exercise) corresponds to a greater extent to the assumptions of the disuse hypothesis (greater gradient of improvement in elderly subjects), or to the assumptions about age-related decline of developmental plasticity (gradient greater of improvement in the young). Accordingly, we want to answer the question: Do the people solving syllogisms at a different age (in late and early adulthood)

differ in: (1) the average level of performance of the tasks (reaction time and accuracy) depending on the contents of syllogisms (stereotypical positive/stereotypical negative/non-stereotypical neutral) and their formal characteristics, such as logical consistency of the conclusions with stereotypical knowledge (consistent/inconsistent) and the logical status of the conclusion (true/false) as well as (2) the degree of improvement of the tasks' performance during the measurement (t_1-t_n)?

Method

The subjects. The sample comprised 90 subjects in two age groups: early adulthood (n = 45, in the range of 20 to 30 years, M = 23.2 years) and late adulthood (n = 45, in the range of 65 to 86 years, M = 73.0 years). The younger group (women n = 26, men n = 19) were students (both humanities and science), employed and unemployed persons. The older group (women n = 33, men n = 12) were subjects who were not diagnosed with dementia or mild cognitive impairment: some people belonged to senior clubs and associations of pensioners. In the younger and older group were mostly people with secondary education. The age groups were selected on the basis of "snowball sampling".

Measurement. In order to measure syllogistic reasoning 12 linear syllogisms have been applied, varied by: (a) the contents (stereotypical beliefs about elderly people: positive, negative; neutral), (b) the consistency of logical and stereotypical conclusions (consistent, inconsistent), and (c) the logical status of the conclusion (true, false) (see table 1). Stereotypes on the issue of age used in the construction of tasks were selected on the basis of studies published in literature, taking into account the highest frequency of stereotypes. The syllogisms eventually used in the study were selected on the basis of their formal eligibility by an expert (logician).

Table 1. Categories of syllogisms used in the measurement

Criteria	Categories of syllogisms											
Contents	Stereotypical positive				Stereotypical negative				Neutral			
Consistency of conclusion	Inconsistent		Consistent		Inconsistent		Consistent		Inconsistent		Consistent	
Logical status of conclusion	T	F	T	F	T	F	T	F	T	F	T	F

Examples of syllogisms, which were used in the study:
(a) neutral contents and incongruence/inconsistency of logic and belief-based conclusions
If a truck has fewer wheels than a car
and a car has fewer wheels than a bicycle
therefore a truck has fewer wheels than a bicycle

(b) stereotypical contents and congruence/consistency of logic and belief-based conclusions
If a grandson is stronger than a father
and a father is stronger than a grandfather
therefore a grandfather is stronger than a grandson

Syllogisms were presented in a random order for each person on a laptop computer screen (17'). The test tasks were preceded by two trial tasks. The purpose of the test was to answer as soon as possible, by pressing one of two buttons on the interface: TRUE (marked in green) or FALSE (marked in red). After giving an answer the screen automatically disappeared without the possibility of returning to it. The next screen was presented by the examiner, when the subject was ready for the next task. The computer program automatically recorded the sequence of exposed syllogisms, the response time (RT) and the number of correct responses (C).

Results

We studied the reaction times (RT) and their correctness (C) in three different experimental conditions: in response to a random block of syllogisms with stereotypical positive, negative and neutral content and varied in formal properties (consistency and logical status of the conclusions). The aim of the study was to determine whether elderly people compared to younger ones cope worse with processing and inhibition of stereotypes in syllogistic reasoning. In the first step, reaction times (RT) and their correctness (C) were analyzed separately using ANOVA with repeated measurements: 3 Content (stereotypical positive/stereotypical negative/neutral) x 2 Age (younger/older) x 2 Gender (female/male). In the second step, the model included a logical consistency of conclusion (consistent/inconsistent with stereotypical knowledge) and their formal status (true/false). In the final step, the model included a degree of improvement in the response time (RT_{1-3}) and separately with regard to their correctness (C_{1-3}). Additionally, cluster analysis was performed (*k*-means clustering) to find patterns of change in the processing of syllogisms (speed and accuracy) based on the age of subjects.

Response time and correctness

An analysis of main effects indicates no influence of the age of life on the response times (RT) of the subjects ($F[1, 88] = 2.15$, $p < 0.14$). Contrary to expectations, it appears that the noticeable delay in the response time of older subjects (65-86 years, $M = 15.82$, $SD = 17.79$) compared with younger subjects (20-35 years, $M = 11.13$, $SD = 11.99$) is not statistically significant (see figure 1). A significant effect of the age of life was found on the correctness (C) of given responses ($F[1, 88] = 104.6$; $p < 0.001$). Subjects in early adulthood gave significantly more correct answers than subjects in late adulthood (younger: $M = 0.82$, $SD = 0.13$, older: $M = 0.51$, $SD = 0.15$) (see figure 2).

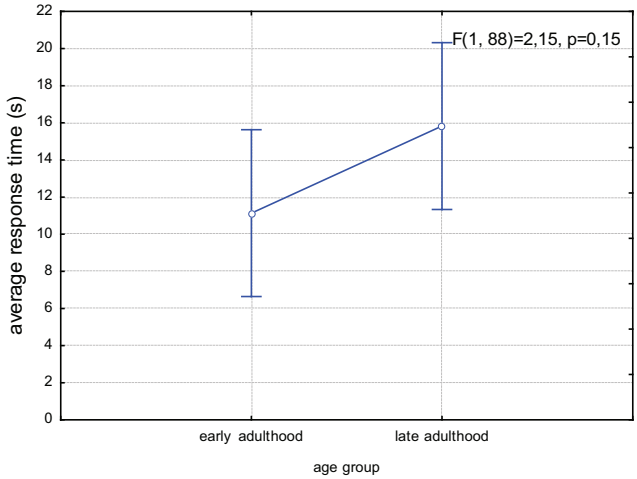

Figure 1. Comparison of the average response time in the studied age groups

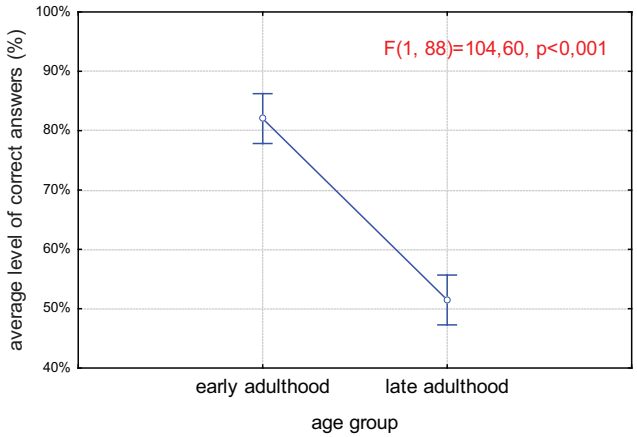

Figure 2. Comparison of the average level of correct answers in the studied age groups

It should be noted that the analysis of the main effects showed no effect of gender in the influence on the time of responses (F [1, 86] = 1.79, $p < 0.19$) and their correctness (F [1, 86] = 2.09, $p < 0.16$).

Inhibition of stereotypes

Data analysis indicates the effect of the content of syllogisms (stereotypically positive/negative/neutral) on the speed of response of the subjects (RT) depending

on their age (F [2, 176] = 8.89, $p < 0.001$). As expected, syllogisms charged with stereotypical content delay response time (RT) of older people (see figure 3). However, it appears that the content of syllogisms does not differentiate in a statistically significant way the correctness of answer (C) in the age groups (F [2, 176] = 1.31, $p < 0.27$). (see figure 4). Interestingly, additional analysis showed that, regardless of the age group, the correctness in syllogisms with stereotypical content (mostly positive stereotypes) is greater than in syllogisms with neutral content (F [2, 176] = 50.26, $p < 0.001$).

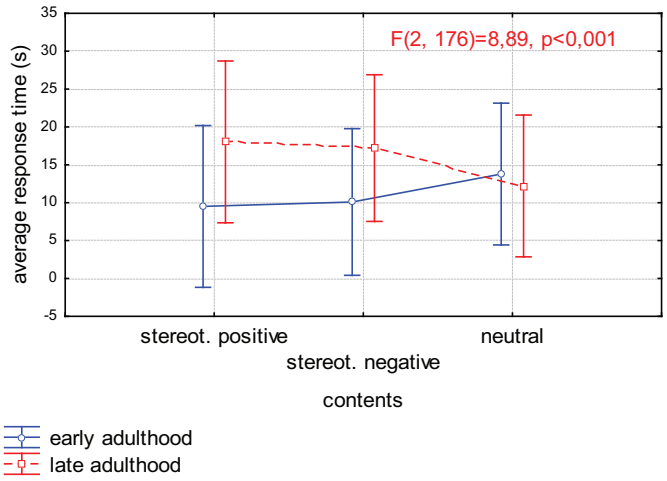

Figure 3. The average response time in the studied age groups depending on the content of syllogisms

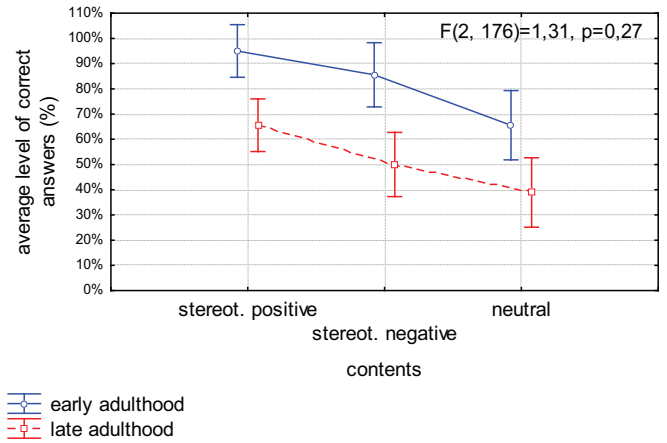

Figure 4. Average correctness of response in the studied age groups depending on the content of syllogisms

Given the formal structure of tasks and related operational requirements, we found that the effect of the content cohesion of the conclusions with judgments based on experience (stereotypes) is independent of the age of the subjects, both for speed (F [1, 88] = 2.23, $p < 0.13$) and correctness (F [1, 88] = 3.11, $p < 0.08$) of their responses. So we can say that whether the conclusions of syllogisms were consistent or inconsistent with the stereotypical knowledge did not differentiate the speed (RT) and correctness (C) of responses of younger and older subjects. In general, in both age groups no differences can be observed in the speed of response (F [1, 88] = 0.05, $p = 0.81$) and greater accuracy for consistent rather than inconsistent syllogisms (F [1, 88] = 31.02, $p < 0.001$).

After including a logical status of conclusions in the model it was also found that the subjects, regardless of age, responded more quickly in case of syllogisms containing true conclusions (F [1, 88] = 13.59, $p < 0.001$). The analysis shows, however, that the logical value of conclusions (True/False) has some effect on the differences in the correctness of processing syllogisms in the age groups. It turned out that older people committed significantly more errors (C) than younger subjects in syllogisms containing false conclusions (F [1, 88] = 14.51, $p < 0.001$), although there were no significant differences between the age groups in the speed of solving syllogisms (RT) involving true/false conclusions (F [1, 88] = 0.43, $p < 0.51$). This means that the logical value of a conclusion can be considered as a factor in explaining the observed main effect of age on the correctness of answers given by the subjects (see figure 2).

The improvement effect

There was no assumed effect of the varying degree of improvement in response time ($RTt_{1\text{-}3}$) and correctness ($Ct_{1\text{-}3}$) of the subsequent tasks during the study of the elderly compared with younger ones. It turned out that despite the assumed differences in the baseline measurement, the differences between younger and older people in three different stages of series of tasks are not statistically significant, both in terms of response speed (F [1, 176] = 0.21, $p < 0.81$) and their correctness (F [1, 176] = 1.64, $p < 0.19$) (see figure 5 and 6).

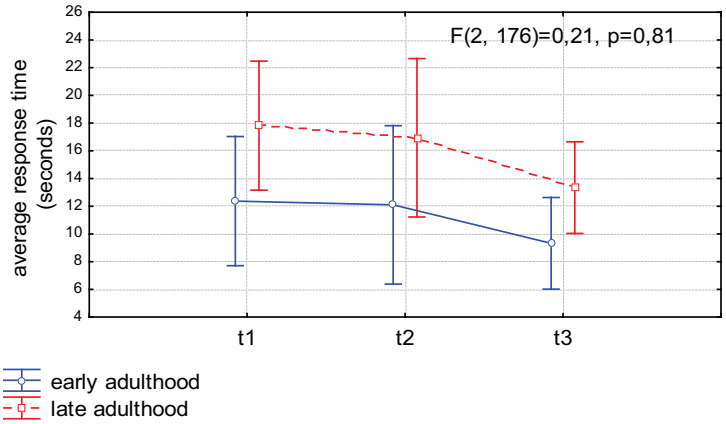

Figure 5. The average response time in the studied age groups in various stages of measurement

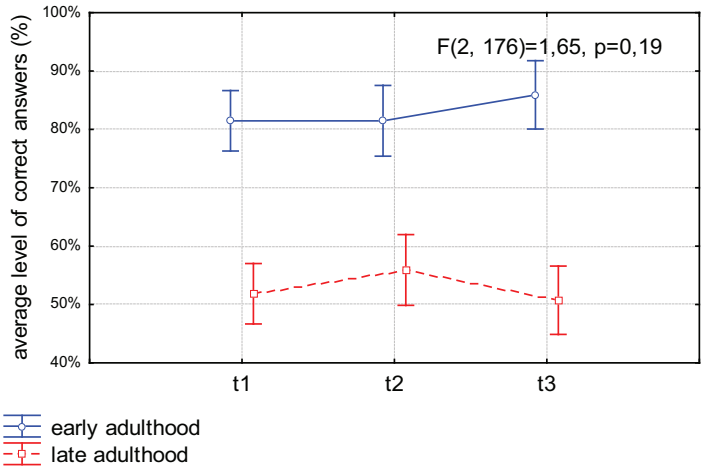

Figure 6. Average correctness of response in the studied age groups in various stages of measurement

It is worth emphasizing that the additional cluster analysis (*k*-means) produced four groups with a different pattern of changes in reaction times (see figure 7) and three groups with a different pattern of changes in the correctness of answers (see figure 8) during the study.

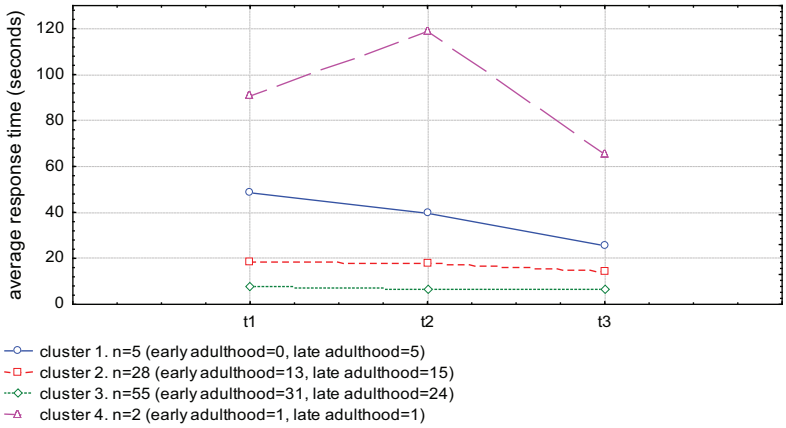

Figure 7. Results of cluster analysis on the grounds of the average response times in various stages of measurement

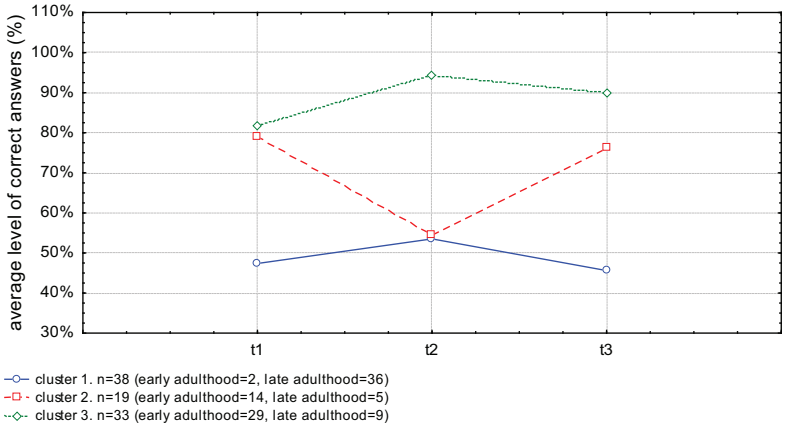

Figure 8. Results of cluster analysis on the grounds of the average response times in various stages of measurement

Generally, apart from the third cluster of the subjects (correctness of response, figure 8), highlighted patterns of changes in the level of performance of syllogisms do not support the assumption of a greater improvement in performance of the tasks by older during testing under the influence of measurement repetition (practice).

In most clusters (except one) representatives of the two age groups are present, although usually in different proportions. These data suggest that patterns of changes in the processing of syllogisms revealed in the analysis are not dependent on the age of subjects.

Conclusions and Discussion

The aim of this study was to verify the hypothesis saying that older people compared to younger are worse at dealing with the processing of stereotypes about aging in syllogistic reasoning, and the degree of improvement that they reach during the test is different than in young subjects. The achieved results are not conclusive and are seemingly contradictory.

Firstly, the analysis of the main effects did not confirm the effect of age of life on the average response time (RT) of younger and older subjects solving syllogisms used in the study. However, there was the influence of age on the correctness of answers (C) of subjects: on average, older people gave fewer correct answers than younger ones. For both the speed of responses and their correctness no influence of the sex of the subjects was found.

Secondly, the analysis of the results confirmed the influence of stereotypical content of syllogisms on the speed (RT) of responses depending on the age of the subjects: in syllogisms containing stereotypical knowledge (about aging) reaction times were longer in the elderly compared to younger subjects. This effect was not found in case of correctness (C) of responses for different ages: younger and older subjects did not differ in correctness of syllogisms' solutions depending on their stereotypical content.

Thirdly, the presented analysis of the role of formal characteristics of the tasks shows that the logical consistency of the conclusions of syllogisms with stereotypical knowledge does not significantly differentiate the level of tasks performance by older and younger subjects in terms of speed (RT) and correctness (C). It turns out, however, that this factor is the logical status of the conclusion: the older people compared to younger did not different in reaction times (RT) in syllogisms containing false conclusions, but significantly more frequently gave incorrect answers (C).

And finally, there were no significant differences between younger and older people in speed (RTt_{1-3}) and correctness (Ct_{1-3}) of syllogisms processing during the test. In addition, the patterns of changes in the speed (RTt1-3) and correctness (Ct_{1-3}) of answers on the subsequent three stages of the implementation of a series of tasks revealed in the cluster analysis demonstrate no relationship with the age old subjects. The changes during the time of measurement are – as expected – in connection with the initial level of the task performance, but they are not explicitly connected to the age of life of patients.

Generalizing the above empirical findings, we can say that, compared with younger people a slowdown in the syllogistic reasoning does not characterize cognitive functioning of people in late adulthood. They can solve syllogisms just as quickly as younger subjects. However, they respond more slowly when the tasks are subject to stereotypical content and less accurately when the conclusions of syllogisms are false.

Slower responses in tasks with stereotypical knowledge about older people may be explained by the problems with inhibition of affective biases related to the individual experience of aging people. Syllogisms containing stereotypical knowledge about elderly probably required older people to have increased cogni-

tive control and took more time to verify the reliability of judgments arising out of their knowledge and belief. However, lower accuracy of syllogisms containing false conclusions can be explained by operational requirements of their solutions which exceed diminishing with the age cognitive resources, such as working memory, attention concentration, attention switching, etc. (Engle et al., 2005). In accordance with the principle of tender between speed and correctness, in a situation in which the load on the cognitive system prevents a simultaneous maintenance of high results in speed and accuracy, there is a preference for one of these aspects (Meyer et al., 1988; Szymura, Słabosz, 2002). The results obtained in the group of older people can be interpreted as a manifestation of this particular phenomenon, namely preferences of maintaining high speed at the expense of correct answers.

Thus, it can be stated that worse level of syllogistic reasoning in older people may be explained by two factors: cognitive bias associated with individual experience, requiring inhibition while solving tasks and formal requirements which engage cognitive resources that weaken with age. However, the question arises as to why older people dealt just as well as younger ones with syllogisms containing conclusions inconsistent with stereotypical knowledge and why they had problems with the accuracy in syllogisms containing false conclusions? This result can be explained in accordance with the empirical findings (Gilinsky, Judd, 1994) that with age in elderly people assessment of accuracy of incorrect but probable reasoning deteriorates. It is not excluded that older people have trouble "switching" the processing of information contained in the used syllogisms from the automatic level (based on knowledge and belief, here: stereotypical) to the analytic level (based on the principles of logic), and/or vice versa. This problem requires a separate study.

The analysis of differences and patterns of changes in the speed and correctness of responses during the test (t_{1-3}) of syllogistic reasoning in the age groups leads to ambiguous statements about the expected influence of the age of life in the improvement of performance of tasks under the influence of measurement repetition (practice). The results of this study do not support any of the considered perspectives, i.e. the disuse hypothesis and the hypothesis of "diminishing developmental plasticity", but they also do not contradict them. Therefore, it is clear that, undertaken in this research project, an attempt to separate from each other the effects of macroscopic (related with the age of life) and microscopic changes (related with the time of measurements) failed for two reasons, which cause that further analysis in this direction has not been taken.

Firstly, on the basis of previous research on cognitive aging (Stuart-Hamilton, 2006; Hofer, Alwin, 2008) we accepted two hidden assumptions, which have not been confirmed. We assumed that subjects in late adulthood show age-related decline in cognitive task performance and on this basis that, compared with younger ones, they would show significantly lower initial levels of syllogistic reasoning. On the other hand, we assumed that more complex functions, including reasoning, "age" slower (see e.g. Engle et al., 2005), while maintaining a high level of developmental reserves and on this basis that older people in comparison with younger ones, starting from a lower level, will show a greater degree of improvement in

the implementation of subsequent tasks during the study, due to the measurement repetition (practice). The achieved results show that the average initial levels of syllogistic reasoning in the age groups are significantly different only for the correctness, whereas they are not relevant for the response times and the tendencies for changes/differences during the test are ambiguous. We believe that the assumption of "slower aging" of reasoning as a more complex cognitive function refers to a very general rule. In the developmental, and therefore dynamic point of view, it appears that aging of reasoning is not monolithic[1].

Secondly, in the present research project, we used a random pattern of syllogisms exposure, which differed formally and contextually in the level of difficulty of the solution. The difficulty effect of randomly presented syllogisms overlaps the effect of changes in the test, which could introduce an error in conclusions about the change on the basis of average values. For example, there may be a kind of "carry-over effect" of the importance of affective and neutral content of the tasks (see Asheley, Swick, 2010). We came to the conclusion that in the search for a model of study, which separates from each other the effects of age (macro-developmental changes) and repetition of measurements during the test (micro-developmental changes) probably more useful is a flowchart of tasks' exposure and comparison of the changes/differences related to age and measurement time. Thus, such studies require an increase of the number of measurements/tasks during the test.

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[1] For example, the results of developmental research in the 80's, ignored in the mainstream of modern experimental studies, have shown that the order of losses and disintegration patterns of reasoning during "aging" is opposite to their acquisition by children and adolescents (causal > proportion > correlation) (see Trempała, 1989). Linear syllogisms used involve reasoning patterns more advanced ontogenetically than a cause-and-effect thinking, the most resistant to losses associated with aging. So it is not inconceivable that the expected regularities would reveal themselves after using tasks involving causal reasoning.

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