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The readiness to invest cognitive effort affects the accuracy of self-reports of visual functioning among elderly

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Abstract This study explored opportunities to improve the accuracy of self-reports of visual functioning among elderly by investigating accuracy as a function of stable differences in cognitive motivation. Self-reports of visual recognition were administered to a sample of 624 elderly participants (ages >56 years), followed by visual screening tests. Cognitive motivation was measured as a personality factor, i.e. the need for cognition. Need for cognition taps the individual's readiness to invest cognitive effort in a task. Although the overall relation between self-reports and screening tests were relatively low (i.e. ranging from 0.31 to 0.37), high-need-for-cognition participants showed stronger correlations between self-reported and actual visual functioning than low-need-for-cognition individuals. In terms of shared proportions of variance between the two types of measures, differences between low- and high-need-for-cognition participants ranged from 4% to 26% across four visual functions. Because need for cognition is an invariant individual difference factor, it is not a useful tool in practice. However, it can be assumed that processes related to need for cognition might be focused on in order to improve the quality of self-reports in diagnostic settings. The results thus suggest that procedures that make respondents focus their attention on the task, make them invest maximal cognitive effort, and make relevant cognitive material optimally accessible, may lead to substantially higher levels of accuracy of self-report visual functioning.

Key words Need for cognition; self-report; visual functioning

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Introduction Vision is one of the core functions that, if starting to deteriorate, has a major on impact on the quality of life of elderly. Early detection of signs of visual impairment is therefore important.

Because extensive physical screening, for instance as part of regular medical check-ups, is often not feasible, self-report measures of visual functioning may provide a helpful means for an easy assessment, which may thus be used to indicate the need for further physical testing.

Obviously, any self-report measure can only be used in practice when it is sufficiently reliable and valid. Reliability and validity are usually established during the scale construction and testing phase of an instrument. The present paper focuses on characteristics of the respondents that might affect the validity of self-reports of visual functioning. In particular, there may be individual differences in how accurately people report on – in this case – their visual functioning. Identifying characteristics that systematically moderate the relationship between self-reported and actual visual functioning may help researchers find ways to improve the quality of self-report techniques in this field of practice.

INDIVIDUAL DIFFERENCES IN COGNITIVE MOTIVATION One variable that might have the potential to relate to the accuracy of self-reports is the individual difference in cognitive motivation, which, in the field of personality and social psychology, is known as the need for cognition.[1,2] Need for cognition refers to a dispositional tendency to engage in and enjoy effortful cognitive activity. To date, a sizeable literature has accumulated, showing that individuals differ widely in this tendency. At one end of this continuum (high need for cognition), individuals possess a high intrinsic motivation to think, research, and, generally, engage in effortful cognitive endeavors. At the other end of the continuum (low need for cognition), individuals lack such intrinsic motivation and prefer to deal with cognitively demanding tasks by relying on relatively simple cues or heuristics. Generally, both styles may lead to satisfactory feelings of making sense of the world around us or of specific information that one is confronted with. What distinguishes high from low need for cognition individuals is the way they accomplish this. While high-need-for-cognition individuals typically tend to allocate relatively much mental effort to the task at hand, low-need-for-cognition individuals tend to employ more superficial and heuristic strategies.

Need for cognition is measured by either a 34-item scale[1] or an 18-item subscale.[3] Both versions have been found to be highly reliable (i.e. coefficient alphas typically >0.80), unidimensional, and gender-neutral. This also holds for the Dutch version of this scale,[4] which has been used in the present study (see ref. 2 for reviews and meta-analyses, including the Dutch scale).

Need for cognition has been found to relate to a variety of phenomena, many of which concern the acquisition, processing, accessing in memory, and retrieval of information.[2] When a task involves one or more of these processes, high-need-for-cognition individuals tend to outperform their low-need-for-cognition counterparts. For instance, high-need-for-cognition individuals acquire more information, whether in natural settings such as media usage[4,5] or in experimental settings,[6] give evidence of thinking more while performing a task,[7-9] and recall more task-relevant material.[10] In addition, high-need-for-cognition individuals seem to have better access to their cognitive systems. For instance,

individuals with a high need for cognition tend to be more self-conscious,[2] have more access to whether traits do or do not describe oneself,[11] and are more likely to respond to cognitive structures that have been activated through cognitive priming techniques.[12]

NEED FOR COGNITION AND THE ACCURACY OF SELF-REPORTED VISUAL FUNCTIONING Why is the need for cognition related to the accuracy of self-reported visual functioning? We assume this may be the case for two reasons. First, reporting on details about visual functioning requires relatively extensive cognitive effort. For instance, when asked to estimate how difficult it is to read numbers in the phone directory, one has to recall instances that resemble this situation, construct an appropriate mental image that contains at least some measure of reading distance as well as a measure of font size, use this mental image to estimate one's visual abilities, and express this estimate in the format that is asked for. As has been convincingly shown in the literature on need for cognition, high-need-for-cognition individuals tend to invest more effort on such endeavors than do low-need-for-cognition individuals. Consequently, it can be expected that the former individuals will do a better job, resulting in verbal estimates that come closer to reality, than the latter.

Second, in addition to expending more effort, high-need-for-cognition individuals may have better access to cognitions concerning their visual abilities. That is, they may have a more accurate and a more salient cognitive representation of their visual functioning, for instance because they have expended more thought and attention to their visual functioning in the past. In sum, we expect that elderly (who formed the sample in the present study) who are high in need of cognition will give more accurate self-reports of their visual functioning than low-need-for-cognition elderly, because they are likely to invest more cognitive effort to such a task, and because they may have more access to relevant cognitions.

Method

PARTICIPANTS AND PROCEDURE Participants were 624 elderly. This sample was randomly drawn from a larger one (n=5279), that forms the Groningen Longitudinal Aging Study (GLAS) baseline sample. The GLAS sample consists of people aged 57 years or older, who lived either independently or in a home for older people in the northeastern part of the Netherlands in 1993. Participants with severe cognitive impairment at baseline (MMSE score <17) were excluded from the larger GLAS sample during the face-to-face baseline interview (n=78).

The present sample consisted of 350 females (56.1%; mean age: 69.0 years; range: 57-90 years) and 274 males (43.9%; mean age: 68.8 years; range: 57-92 years). Participants were physically and psychologically tested for one entire day in a research program on the functioning of elderly. Visual screening tests made up part of the physical test program. The need-for-cognition scale was part of the psychological test battery. Self-reports of visual functioning were administered through a questionnaire, which was filled out at home before the testing day, and

which participants delivered before the other tests took place. A total of 608 participants provided complete data.

SELF-REPORTED VISUAL FUNCTIONING Self-reported visual functioning comprised thirteen items about visual functioning in everyday life, such as 'Can you read numbers in a phone book', 'Can you see bicycles and cars approaching in the street', with response categories 'hardly ever', 'sometimes', 'often', and 'nearly always'. Factor analysis revealed a dominant first factor, that comprised eight items, coefficient alpha =0.83. These items can be summarized as 'recognition'.[13] They were averaged in order to form a self-reported visual recognition score.

VISUAL SCREENING TESTS Visual acuity, contrast sensitivity, near-reading acuity, and foveal light sensitivity were measured in the participants' best eye. Visual acuity was measured using the ETDRS log MAR wall chart, which meets the Visual Acuity Measurement Standard.[14] Contrast sensitivity was measured with the GECKO, an edge-contrast sensitivity chart that was designed for this study and for use in contrast sensitivity assessment among visually impaired participants.[15] Both charts were viewed from a distance of three meters. Illumination was 500 lux. Near vision was tested with a chart containing four lines of seven words for every character size (type font 'times'). The chart was designed in accordance with current ideas on near vision acuity tests.[16,17] The reading chart was illuminated by an incandescent desk lamp (300 lux), and participants read the chart at their preferred viewing distance. Foveal light sensitivity was measured with the Friedman central field analyzer.

NEED FOR COGNITION Need for cognition was measured with the 12 highest loading items of the Dutch scale for need for cognition.[3,4] After appropriate rescoring of the reverse-formulated items (i.e., 6 of 12), an average need for cognition score was further used in the analyses.

Results Across the total sample, correlations between self-reported visual recognition and the four screening tests, i.e., visual acuity, contrast sensitivity, near vision, and foveal light sensitivity, were 0.37, 0.33, 0.31, and 0.37, respectively (all $p<0.001$). In order to inspect these relationships as a function of the participants' level of need for cognition, the sample was split as close as possible to the tertiles of the distribution of the need-for-cognition scores. Participants were thus designated as being low (n=188), medium (n=195), or high (n=225) in need of cognition. For each subgroup, self-reported visual recognition was correlated with visual acuity, contrast sensitivity, near vision, and foveal light sensitivity, respectively. Table 1 presents these correlations, together with tests of Fisher-Z transformed correlations between the low- and high-need-for-cognition groups.

As was expected, correlations between self-reported visual recognition and the screening tests were smaller for low- than for high-need-for-cognition participants. The differences in correlations were significant for visual acuity, near vision, and foveal light sensitivity, but not for contrast sensitivity. The largest difference was found for near focus.

NC subgroup	*Visual acuity*	*Contrast sensitivity*	*Near vision*	*Foveal light sensitivity*
Low NC	0.36	0.31	0.16	0.29
Medium NC	0.28	0.30	0.20	0.39
High NC	0.47	0.37	0.53	0.41
Z (low-high)	1.86*	0.94	7.64***	1.96**

*p<0.10; **p<0.05; ***p<0.001.

TABLE 1. Correlations between the four visual screening tests and selfreported visual recognition for low-, medium-, and high need-for-cognition (NC) participants and tests of Fisher-Z transformed correlations between the low- and high-need-for-cognition subgroups.

Discussion First, given the 0.31-0.37 range of correlations between self-reported recognition and the four screening tests, it is obvious that self-reports of visual functioning are poor predictors of physical tests. However, when self-reports are taken (e.g., in diagnostic settings where no other measures are available), it is necessary to have knowledge about how such reports may optimally be collected.

The results of the present study suggest that there are systematic individual differences in the accuracy of self-reports of visual functioning. Self-reports from participants with low intrinsic motivation to invest mental effort to cognitive tasks (low need for cognition) were less strongly related to measures of actual visual functioning than those from participants with high motivation (high need for cognition). In terms of shared variance between the two types of measures, the difference between low- and high-need-for-cognition participants varied from 4% to 26% (mean difference: 12%) across the four screening measures. In other words, high-need-for-cognition participants' self-reports were more accurate (even substantially so in the case of near vision) than those of low-need-for-cognition participants.

This moderating role of the need for cognition may stem from the high-need-for-cognition participants, compared to low-need-for-cognition participants, because they invest more effort in the task of providing the self-reports, as well as from the possibly higher accessibility of cognitions among high-need-for-cognition participants concerning past and present visual functioning.

Given that high-need-for-cognition individuals are more strongly motivated to think about and solve problems than low-need-for-cognition individuals, higher accuracy among the former group may also stem from the fact that they may have been thinking more extensively about visual problems in the past and may have developed coping strategies in order to adapt to visual problems in everyday life. Possibly, high-need-for-cognition individuals observe their own behavior (including their limitations in functioning) better than do low-need-for-cognition individuals in general. An alternative explanation might be that high-need-for-cognition individuals expose themselves more frequently to the boundaries of their visual functioning, in particular all kinds of reading activities, which gives them better insight in their functioning.

What are the practical implications of these results, given the fact that we are dealing with a stable and relatively invariable individual difference factor? It is obvious that screening people on their level of

need for cognition is not very useful in the diagnosing practice. However, what seems important here are the underlying processes that are related to the need for cognition rather than need for cognition as a factor per se. Therefore, assuming that the more an individual (a) allocates attention and invests effort in the self-report task and/or (b) has access to relevant cognitions in memory, this may enhance the accuracy of self-reports. One may therefore think of ways to optimize these processes in the procedure of administering the self-report instrument. For example, concerning attention and effort, utmost attention to the instructions for the self-report questionnaire seems essential in order to optimally motivate the respondents to focus their attention and invest effort to the task at hand. Access to relevant cognitive material may be improved by the way respondents are asked about their visual functioning. For instance, rather than asking 'Can you read numbers in a phone book', one may ask respondents to think of the last time they can remember looking in the phone book or a situation similar to that, what were the circumstances concerning light, distance, and so on, and then ask how well they could read numbers. In other words, attempts could be made to lead respondents to 'marker points' in their memory, which may then trigger episodic memory traces concerning actual situations in which the respondent had to exercise his or her visual abilities. If such procedures are developed and used in administering self-reports, accuracy may improve. The differences between low- and high-need-for-cognition participants in the present study in terms of the percentages of shared variance of self-reports and screening tests suggest that improvements might be considerable, at least concerning some visual functions.

Note, the present results were based on a domain-aspecific individual difference factor. Therefore, it could well be that designing procedures that are specifically aimed at improving the accuracy of self-reported visual functioning may yield much higher improvements than the estimated gains based on the differences between the need for cognition subgroups.

In conclusion, although self-reports of visual functioning will always be a relatively poor proxy of actual screening tests, the use of self-reports in situations where screening tests cannot be taken might be useful. The results of the present study suggest that the quality of self-reports may be substantially improved if the procedures are developed that make respondents focus their attention on the task, make them invest maximal cognitive effort, and make relevant cognitive material optimally accessible.

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