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# Knowledge *of* and *about* science benefits people's shallow evidence evaluation

## Introduction

When answering question that relate to scientific information relevant to their daily lines, people need to judge the plausibility of evidence. For this, there are two possible strategies (Bromme, Thomm, & Wolf, 2015):

> **First-hand evaluation**: Assessing the veracity of claims, requiring direct judgment about evidence and arguments provided (e.g. numbers from studies)

> **Second-hand evaluation**: Believing what experts say, requiring judgments about features of experts (and making inferences from there).

Higher scientific literacy could benefit such evaluations of scientific information. In recent educational frameworks (National Research Council, 2012; OECD, 2006), scientific literacy is construed as consisting of two components:

> **Knowledge of science (KOS)** entails knowledge of basic scientific facts, e.g. knowing that a light year measures distances.

> **Knowledge about science (KAS)** entails "understanding of the characteristics of science as a way of acquiring knowledge" (OECD, 2006, p. 23), e.g. knowing what makes a good experiment, or how to derive conclusions from evidence.

However, due to laypeople's limited KOS and KAS (Bromme & Goldman, 2014), first-hand evaluation might be difficult, while second-hand evaluation might be more feasible; reaching a (rather shallow) plausibility judgment is achievable without much knowledge of and about science.

We expected that:

> ... Higher KOS and KAS scores relate to the extent participants differentiate strong and weak scientific evidence.

> ... Higher KOS and KAS scores lead to better differentiation in case of statistical evidence (supporting a claim using numbers), but not for expert evidence (supporting a claim using expert statements).

## Methods

231 Participants:

> 18-93 years of age ($M$ = 37.22, $SD$ = 15.94)

> 54 % female / 46 % male.

2x2 repeated measures design:

> Strong or weak *statistical evidence* (high or low numerical probability)

> strong or weak *expert testimony* (highly pertinent or rarely pertinent expert)

> DV: Plausibility of claims

> Materials: Four scientific claims (how a certain food was related to cancer risk) were presented to every participant, but it was varied across them, which claim was associated with which of the four conditions (Latin Square).

21 items assessing participants' scientific literacy:

> KOS: 12 multiple-choice items (Pew Research Center, 2015)

> KAS: 9 multiple choice items (Fives, et al. 2014; Marschall, et al. 2011)

> We computed factor analyses (IRT) for each scale, retaining only items that would load on one coherent factor with loading $>$ .32. Internal consistency (KR-20) for KOS (8 items remaining) was .52, for KAS (8 items) was .76.

## Results

We performed an ANCOVA with two within-factors (type of evidence and strength of evidence) and the covariates KOS and KAS (centered around their respective means). The following effects were observed:

> *type of evidence* ($F$(1, 228) = 27.02, $p < .001$, $n_p^2 = .12$)

> *strength of evidence* ($F$(1, 228) = 67.13, $p < .001$, $n_p^2 = .23$)

> *Type of evidence * strength of evidence* ($F$(1, 228) = 4.37, $p = .04$, $n_p^2 = .02$)

> *KOS* ($F$(1, 228) = 5.43, $p = .02$, $n_p^2 = .02$)

> *KAS * strength of evidence* ($F$(1, 228) = 11.75, $p = .001$, $n_p^2 = .05$)

> There were no further significant main or interaction effects.

*Table 1.* Means and Standard Deviations for plausibility judgments.

| Type of Evidence | Strength of Evidence | N | Mean | SD |
|---|---|---|---|---|
| Statistical | High | 231 | 2.77 | 1.22 |
| | Low | 231 | 2.07 | 1.11 |
| Expert | High | 231 | 2.97 | 1.21 |
| | Low | 231 | 2.55 | 1.22 |

*Notes.* Scale reached from 1= *not at all plausible* to 6 = *very plausible.*

## Conclusions

Results showed that in general, plausibility of claims was rated higher when based on expert testimony than on statistical evidence. Strong evidence led to higher ratings than weak evidence. The interaction indicates that plausibility judgments for strong and weak evidence varied more for claims based on statistical evidence than for claims based on expert testimony (for means, see Table 1). KAS increased the difference between plausibility judgments for weak and strong evidence. Higher KOS was related to more critical judgments of plausibility.

Our study shows that science literacy (both KOS and KAS) has some influence on shallow evidence evaluations. Emphasizing in science teaching not only facts, but also how knowledge about the (natural) world is generated will likely benefit laypeople's evaluations of scientific evidence in everyday life (Feinstein, 2011).

## Literature/References

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