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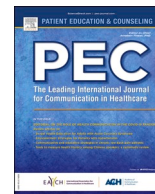
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# The health communication orientations scale: Development and two-country validation of a questionnaire that measures health communication style preferences

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## ABSTRACT

**Objective:** Self-Determination Theory posits that everyone has a basic need for autonomy that needs to be fulfilled to establish autonomous motivation for health behavior (change). Regardless, individual differences exist in health communication style preferences. This paper outlines the development and validation of the Health Communication Orientations Scale (HCOS), a new measure to assess these preferences.

**Methods:** Nationally representative online panels from the US (n = 603) and the Netherlands (n = 737) completed a survey containing the HCOS, established motivational measures, and demographic questions.

**Results:** Factor analyses identified five subscales valid for both populations: HCOS (1) Expert, (2) Others, (3) Self, (4) Oppositional, and (5) Internet. Scores for Expert and Internet were higher in the US sample; Others, Self, and Oppositional were higher in the Dutch sample. Internal reliability for the five factors was high across samples (range 0.84–0.91). Many significant correlations with established measures were observed in both samples indicating the construct validity of the scale.

**Conclusion:** The HCOS subscales have strong psychometric properties.

**Practice implications:** The HCOS represents a novel approach to assessing communication style preferences for general and patient populations. Further investigation in how the HCOS may be used to tailor health messaging is warranted.

## 1. Introduction

Autonomous motivation is important for the initiation and maintenance of health-related behavior (change), and is associated with positive health outcomes [1]. This autonomous motivation, according to Self-Determination Theory (SDT), is more likely to occur when key psychological needs are met, particularly the needs for autonomy and competence. Although SDT suggests that everyone has a basic need for autonomy, individual differences in how this need manifests, for example in terms of health communication style preferences, have been found to exist. To elaborate, some people prefer to choose their own path towards lifestyle improvement, while others prefer to be guided by expert advice [2], [3]. Similarly, some individuals may prefer a more

patient-driven decision while others prefer a more provider-driven decision [4].

This idea finds support in prior research showing individual differences in health communication style preferences [5], [6], [7], [8], [9]. These individual differences might have important implications for health communication research and practice. This becomes evident from several studies where this theoretical construct was found to moderate intervention effects. Customization in mobile health apps, for example, was found to lead to higher intentions to engage in physical activity but only for those with a greater need for autonomy when it comes to their health-related decisions [7]. Also, the provision of choice increased the effectiveness of digital forms of health communication more for people with a high need for autonomy than for people for a low need for

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autonomy [8]. Similarly, people with a greater preference for autonomy-supportive communication, benefited more from newsletters that were framed to be autonomy-supportive than from newsletters with no such message frame. This applied to health communication aimed to increase colorectal cancer screening [3] as well as to messages addressing fruit and vegetable intake [2]. More insight into the individual differences in health communication style preferences might enable health communication researchers to better understand for whom a health communication intervention will (not) work, and to inform tailored health communication based on these attributes.

Accounting for individual differences in communication style preferences may result in health communication materials being more likely to be read, seen as personally relevant, and processed in-depth, which increases both uptake and (behavioral) impact [10]. This is supported by a study by Altendorf et al. (2020), showing that message frame-tailoring (i.e., adjusting *how* a message is communicated based on individual differences in needs and/ or information processing styles [11]) on top of conventional content-tailoring techniques resulted in greater perceived message relevance [12]. Again, however, this effect only existed for people with a high need for autonomy. Before tailoring based on these individual differences is possible, however, a necessary first step is creating valid and feasible measurement. Many of the studies listed above [5], [6], [7], [8], used a measurement for health communication style preferences that was based on the General Causality Orientations Scale (GCOS [13]). However, varying approaches to conceptualization and measurement were applied, with differences in for instance the terminology used (e.g., need for autonomy [5], [6], [7], [8], [9], preference for autonomy-supportive communication [2], [3]), the number of scenarios included (e.g., ranging from two [9], to four [6] and five [7] scenarios), the response scales used (e.g., 5-point [5], [6], [8] or 7-point [7], [9]), and the contexts described (e.g., smoking cessation [6], diabetes [7]) or health in general [5], [7], [8], [9]). Also, tailoring health communication based on individual health communication style preferences is likely easier and more effectively done when these preferences are assessed specifically in relation to health communication instead of as relatively enduring aspects of personality, as in the GCOS [13]. Therefore, the objective of this study was to develop, pilot test and validate a cross-cultural version of a measure of health communication style preferences, the Health Communication Orientations Scale (HCOS), with a clear definition of the concept, a fixed structure and designed to be used in the context of multiple health behaviors.

The HCOS measures health communication orientations, i.e., a person's orientation towards a certain way of communicating about health. In other words, a person's health communication style preferences. Based on the GCOS and suggestions from previous empirical work [9], [12], we decided that it would be important to measure a person's self orientation, their external orientation, and to what degree they have no active orientation, or amotivation to change their health or health-related behavior. On top of that, we added items that reflect an oppositional orientation. Psychological reactance theory [14] proposes that a threat to autonomy, for example when receiving a suggestion to alter one's health related behavior, may induce reactance, i.e., a state of motivational arousal that leads to a subsequent action to restore the threatened autonomy (e.g., not adhering to the suggestion given). Earlier empirical work [15] suggests that individuals may differ in their reactance proneness, i.e., the ability to experience greater levels of reactance – with reactance proneness and the need for autonomy being suggested as distinguishable concepts that seem to reinforce each other [5]. We also added items reflecting an orientation towards online searching, since already for over a decade the Internet is the most often consulted medium when people need health related information [16], and over the years there has been an enormous increase in behavior change interventions that use digital technology for public health and behavioral medicine [17].

## 2. Methods

This tool development and validation study was reviewed by the University of Michigan IRB and deemed exempt from ongoing human participants review as no identifying information was collected from participants. The protocol was also approved by the ethics committee of the University of Amsterdam (reference number: 2021-PC-12470).

### 2.1. Scale development

The Health Communication Orientations Scale (HCOS) scale was created to assess an individual's health communication orientation or orientation towards a certain way of communicating about health (i.e., a person's health communication style preferences). Based on the rationale described in the previous section, we developed items in six orientation domains: 1. External orientation towards experts 2. External orientation towards peers 3. Self orientation 4. An oppositional orientation 5. An orientation towards online searching 6. No active orientation, or amotivation. For each type of orientation, we included two questions related to health in general and two questions related to a specific behavior, i.e., nutrition, to determine if the orientation is a generalizable attribute or a more task/ behavior specific attribute. Of each set of two questions, one question addressed the respondent's preference for how they develop motivation (i.e., the "why" dimension, e.g., *How much would you prefer to determine for yourself why to change your behavior?*) and one question addressed their preference for determining what changes to make (i.e., the "what" dimension, e.g., *How likely are you to ask the health professional what changes to make to your behavior?*). This makes for a total of four questions per orientation domain, summing up to 24 questions in total. All items were answered using a 7-point scale (1 = not at all to 7 = very much for the why dimension; 1 = very unlikely to 7 = very likely for the what dimension). A full list of items can be found in Table 2.

Measures were translated into Dutch using the forward and backward translation method. Subsequently, all items were reviewed by professional colleagues from the fields of public health, health promotion and health psychology and revisions were made based on their recommendations.

### 2.2. Construct validity

To explore the construct validity of the HCOS, we included motivational measures and items about health literacy. Hypotheses about correlations of HCOS subscales with validity measures were pre-registered with the Open Science Framework (OSF) prior to conducting the survey [18] and are described in detail in Appendix 1.

#### 2.2.1. Validity measures

Need for cognition (NFC) was measured using a 9-item scale, available in English and Dutch [19], [20]. For each item, respondents rated themselves on a 5-point scale (1 = "not at all true for me"; 5 = "very true for me"). The items included statements like "I would prefer complex to simple problems", with higher scores indicating a higher NFC. Cronbach's alpha was 0.81 (US) and 0.83 (NL).

Desire for involvement in decision-making was measured for health generally and nutrition specifically, using scales previously developed and used by the authors [3], [8]. We asked three questions about preferences in decision making regarding health in general and about nutrition specifically, e.g., "When it comes to my health, I prefer an expert to tell me what to do." Each question was answered on a 7-point scale (1 = strongly disagree; 7 = strongly agree), with higher scores indicating a lower desire for involvement. Reliability was better when health and nutrition items were combined, so we combined all six items in all subsequent analyses (Cronbach's alpha was 0.72 for the US and 0.69 for the NL sample).

We measured authoritarianism using the brief authoritarianism scale

[21]. This 6-item scale assesses right-wing tendencies using a 7-point scale (1 = strongly disagree; 7 = strongly agree), and items like “It is great that many young people today are prepared to defy authority”. Higher scores indicated a higher sense of authoritarianism. Cronbach’s alpha was 0.71 (US) and 0.58 (NL).

Reactance was measured using the Hong psychological reactance scale [22], comprising 5 questions answered along a 5-point scale (1 = strongly disagree; 5 = strongly agree), e.g., “I become angry when my freedom of choice is restricted”, with higher scores indicating more reactance. Cronbach’s alpha was 0.83 (US) and 0.78 (NL).

We used the 16-item treatment self-regulation questionnaire (TSRQ; [23]) to assess three classes of motivation; autonomous, controlled, and amotivation. The stem was modified to fit general health behavior (i.e., “The reason I would change my health behavior...”) and specific nutrition related behavior (“The reason I would eat healthier or exercise more is...”). Statements included “Because I personally believe it is good for my health” (autonomous), “Because others would be upset with me if I didn’t” (controlled), and “Because it is easier to do what I am told than think about it” (amotivation), with higher scores indicating a stronger motivation. All responses were answered on a 7-point scale (1 = not at all true; 7 = very true) with Cronbach’s alpha being 0.88 (US and NL) for the autonomous subscale, 0.86 (US) and 0.84 (NL) for the controlled subscale, and 0.66 (US) and 0.61 (NL) for the amotivation subscale.

Health literacy was assessed with two items: 1) “How often do you need to have someone help you when you read instructions, pamphlets, or other written materials from your doctor or pharmacy?” (Never, rarely, sometimes, often, always), i.e., The Single Item Literacy Screener (SILS) [24], and 2) “How confident are you filling out medical forms by yourself?” (extremely, quite a bit, somewhat, a little bit, not at all) [25].

### 2.3. Survey administration

We fielded the online surveys in December 2020 using the research panels Dynata (US) and PanelClix (NL). We wanted completed surveys for 750 respondents from each country based on a priori power calculations that were based on both precision of response (95% confidence that estimates are within +/- 3% error) and power to detect correlations (assuming correlations above .2 and alpha of .05) and aimed to allow for potential subgroup analyses, since people with different communication style preferences were previously found to differ in their gender, age and educational level [9].

Respondents who answered all questions in the HCOS set with the same response, i.e., they agreed or disagreed to all items even though the items referred to different types of communication style preferences, were not considered complete cases. Furthermore, we excluded any responses completed in under 3 min, which we considered to be the threshold for reasonable minimum completion time ( $n = 42$  (NL);  $n = 692$  (US)).

### 2.4. Statistical analysis

To determine the factor structure of the HCOS, exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) were conducted (factor cutoff: 0.65). In preparation, we examined the data for appropriateness for factor analysis. Bartlett’s test of sphericity was significant ( $p < 0.001$ ) in both the pilot study and main study. The Kaiser-Meyer-Olkin value was  $> 0.80$  in both samples. This indicates a good fit for factor analysis.

Then, reliability analyses were conducted in the two samples separately as well as using the data from both countries combined.

To test the hypotheses in relation to the scale’s validity, we first examined bivariate correlations between each validity measure and the HCOS subscales, run separately by country. Then we combined data from both samples and ran an adjusted model including an interaction between country and the validity measure to test where these relationships diverged by country significantly. These linear regression models

were adjusted for age, gender, household income, and education. Exploratively, interactions between gender and the validity measures were also tested, but no systematic differences by gender were identified.

All analyses were conducted in Stata 15.1 for Windows and MPlus.

## 3. Results

### 3.1. Pilot study

The HCOS was pilot tested with a sample of Dutch and US participants drawn from the same research panels used for the main study ( $N = 232$ ; 95 Dutch and 137 US participants). In this pilot test, we assessed respondents’ ability to answer the questions and provide a range of responses and tested the initial factor structure of the scale.

In this pilot study, we found a 5-factor structure that worked for both the US and NL sample, and that excluded the four amotivation items from the solution. Yet, to not be too quick in our dropping of this subscale, we decided to proceed to the main study with all 24 original items.

### 3.2. Main study

A total of 1340 respondents met our survey completion criteria: 603 from the US and 737 from NL. The sample was split between men and women (46.7% vs. 53.3%) and by age (55.3% ages 18–54, 44.7% ages 55+).

First, we examined the 24 HCOS items using EFA with principal component extraction and varimax rotation using Stata 15.1 for Windows. We identified a 5-factor solution with similar factor loadings for both samples. This solution used 20 of the original items, dropping the 4 items related to amotivation. This 5-factor solution was then tested for overall model fit and invariance between US and NL respondents using CFA in MPlus.

In the CFA model, we treated all scale items as categorical and ordinal, and compared the measurement invariance between a configural invariance model (configural model: Chi-square = 1023.3,  $df = 320$ , RMSEA = .06, TLI = .98, CFI = .99) and model which constrained thresholds, factor loadings, and scale parameters (scalar model: Chi-square = 666.7,  $df = 130$ , RMSEA = .06, TLI = .98, CFI = .98). While we found that the scalar invariance model had a worse fit than the configural model, the factor structure of the first model held solidly in both groups.

The five factors that we identified are HCOS Expert (4 items), HCOS Others (4 items), HCOS Self (4 items), HCOS Oppositional (4 items), and HCOS Internet (4 items). The means for the five factors for the US and NL samples can be found in Table 1. Means for the individual items and factor loadings in Table 2. Cronbach’s alphas for the five retained scales were consistently high across both the US and NL samples (Table 2). In the combined sample, HCOS Expert had an alpha of 0.89, HCOS Others 0.90, HCOS Self 0.86, HCOS Oppositional 0.90, and HCOS Internet 0.91. Scores were higher for HCOS Expert and HCOS Internet in the US and higher for the remaining scales in the NL sample, yet alphas remained high for each national sample separately (range 0.84–0.91).

As shown in Table 3, the scores for HCOS Expert were significantly positively associated with need for cognition ( $r = 0.07$ ;  $r = 0.09$ ), desire for involvement in decision making ( $r = 0.25$ ;  $r = 0.40$ ), autonomous ( $r = 0.28$ ;  $r = 0.42$ ) and controlled motivation from the TSRQ ( $r = 0.11$ ;  $r = 0.20$ ), and health literacy ( $r = 0.08$  to  $r = 0.14$ ), across both countries, and significantly negatively associated with reactance ( $r = -0.13$ ;  $r = 0.20$ ) and amotivation ( $r = -0.12$ ;  $r = -0.18$ ).

HCOS Others was significantly positively associated with desire for involvement in decision making ( $r = 0.44$ ;  $r = 0.52$ ) and controlled motivation ( $r = 0.34$ ;  $r = 0.48$ ) in both samples. It was also positively associated with autonomous motivation ( $r = 0.18$ ) in the NL sample and with authoritarianism ( $r = 0.13$ ), reactance ( $r = 0.27$ ) and amotivation ( $r = 0.34$ ) in the US sample. It was significantly negatively associated

**Table 1**  
Demographic characteristics of study sample.

	Total (n = 1340)	US (n = 603)	NL (n = 737)	p-value
Age (%)				
18-34	21.9%	21.4%	22.3%	0.04
35-54	33.4%	34.3%	32.7%	
55-74	39.9%	37.8%	41.7%	
75 +	4.8%	6.5%	3.4%	
Gender (%)				
Man	46.7%	41.8%	50.5%	0.002
Woman	53.3%	58.6%	49.5%	
Race/Ethnicity (US only, %)				
Non-hispanic white		75.8%		
Non-hispanic black		8.9%		
Hispanic		10.8%		
Other		4.5%		
Education-has university degree (%)				
No	64.5%	58.6%	69.2%	<0.001
Yes	35.5%	41.4%	30.8%	
Total household income (US equivalent, %)				
<\$50,000	55.3%	49.4%	60.3%	<0.001
\$50,000 or more	44.7%	50.1%	39.7%	
HCOS scales (Mean and SD)				
Expert	5.07 (1.54)	5.50 (1.32)	4.72 (1.62)	< 0.001
Others	3.36 (1.47)	3.21 (1.60)	3.48 (1.34)	< 0.001
Self	5.21 (1.26)	4.79 (1.40)	5.56 (1.06)	< 0.001
Reactance	3.81 (1.67)	3.59 (1.73)	3.99 (1.60)	< 0.001
Internet	4.21 (1.58)	4.40 (1.65)	4.06 (1.50)	< 0.001

with health literacy ( $r = -0.22$ ;  $r = -0.35$ ) in the US sample.

HCOS Self was significantly positively associated with autonomous motivation across both samples ( $r = 0.23$ ;  $r = 0.38$ ) and with need for cognition ( $r = 0.12$ ) and health literacy ( $r = 0.10$ ;  $r = 0.16$ ) in the NL sample, and reactance ( $r = 0.15$ ) and controlled motivation ( $r = 0.15$ ) in the US sample. It was significantly negatively associated with desire for involvement in decision making in both samples ( $r = -0.20$ ;  $r = -0.21$ ) and with controlled motivation ( $r = -0.08$ ) and amotivation ( $r = -0.26$ ) in the NL sample.

HCOS Oppositional was significantly positively associated with reactance ( $r = 0.25$ ;  $r = 0.35$ ) and amotivation ( $r = 0.24$ ;  $r = 0.34$ ) in both samples and with controlled motivation ( $r = 0.13$ ) in the US sample. It was significantly negatively associated with need for cognition ( $r = -0.09$ ;  $r = -0.12$ ), desire for involvement in decision making ( $r = -0.16$ ;  $r = -0.36$ ), and autonomous motivation ( $r = -0.17$ ;  $r = -0.19$ ) in both samples, controlled motivation ( $r = -0.10$ ) in the NL sample, and health literacy ( $r = -0.10$ ;  $r = -0.19$ ) in the US sample.

Finally, HCOS Internet was significantly positively associated with need for cognition ( $r = 0.12$ ;  $r = 0.16$ ), desire for involvement in decision making ( $r = 0.09$ ;  $r = 0.13$ ), autonomous motivation ( $r = 0.17$ ;  $r = 0.26$ ), and controlled motivation ( $r = 0.15$ ;  $r = 0.28$ ) in both samples, and reactance ( $r = 0.15$ ) in the US sample. It was significantly negatively associated with amotivation ( $r = -0.13$ ) in the NL sample, and with health literacy in the US sample ( $r = -0.10$ ).

## 4. Discussion and conclusion

### 4.1. Discussion

We developed a version of the HCOS (Health Communication Orientations Scale) that had a similar factor structure and validity across two countries (i.e., the US and the Netherlands). The final ‘‘cross cultural’’ version comprised 5 factors, using 20 of the original 24 items. The

five factors (4 items each) were named Expert, Others, Self, Oppositional, and Internet. The best model fit combined items related to health in general and related to nutrition specifically, suggesting the attributes measured may be stable rather than task specific or context bound orientations.

Scores were higher for Expert and Internet in the US sample and higher for the remaining scales, i.e., Self, Oppositional, and Others, in the NL sample. This may indicate that Americans are more willing to rely on medical advice and digital information than the Dutch. In contrast, the Dutch may place greater value on individual autonomy in health-related decisions, possibly reflected in their higher scores on reactance, and may be more open to advice from friends, family, and colleagues. Somewhat, these differences may be related to other differences in the two samples. To elaborate, the US sample consisted of relatively more women and more respondents with a university education, with women making up almost 60% of the so-called ‘‘confirmation-seekers’’, i. e., reporting relatively high scores on their orientation towards external advice from experts and/or peers [9]. These confirmation-seekers were additionally found to be relatively higher educated. Yet, this same group also reported high scores on autonomous orientation, which was higher in the NL sample, so no firm conclusions can be drawn here.

Generally, correlations between the HCOS scales and validity measures were in the hypothesized direction and the pattern of association did not significantly differ between the US and NL samples. There were two instances where the association between the HCOS subscales and a validity measure was in the opposite direction across the two countries, and significant in both, thus observing opposing validity. First, in the US sample, the HCOS Self subscale was positively correlated with controlled motivation (TSRQ), yet negatively associated with controlled motivation in the NL sample; only the latter pattern was a priori hypothesized. Second, controlled motivation was positively correlated with HCOS Oppositional in the US but inversely correlated with HCOS Oppositional in the NL sample. Again, we only hypothesized what was found in the NL sample. In both cases the unexpected finding was thus observed for the US sample and for the controlled motivation scale of the TSRQ. This suggests there may be cross cultural differences in how controlled motivation manifests, what drives autonomy and what triggers reactance. It may be that in the US, though not in The Netherlands, autonomous orientation may include active use of guilt, shame, and judgment from others as part of the decision-making process. This is supported, at least in part, by the finding in our sample that the Dutch respondents scored higher on HCOS Self and Oppositional, and lower on HCOS Expert than the US sample. Future studies examining the relationship between HCOS responses and TSRQ in other cultures would help elucidate our findings. It should be noted, however, that while the HCOS x Country interaction term was significant in these two instances, the magnitude of the correlations on either side were only small to moderate.

In other cases where there was a significant HCOS x Country interaction it was either because the strength of the association differed in magnitude, or the association was only significant for one of the countries. For example, reactance was significantly and positively correlated with the HCOS Others in the US, yet uncorrelated in the NL sample. This may indicate that reactance may manifest itself differently in the two countries, with reactance being culturally prominent in the US [26]. There were also a few examples of the observed association being in the opposite direction as hypothesized. For example, across both samples, autonomy on the TSRQ was positively associated with the HCOS Expert subscale whereas we had hypothesized a negative association. This may indicate that if you have high autonomous motivation, you may be open to receiving outside advice, as long as that decision was made volitionally [4].

### 4.2. Strengths and limitations

Strengths of the study include the use of two nationally

**Table 2**  
Exploratory factor analysis of HCOS scale.

EFA	US Respondents					Dutch Respondents				
	Factor 1: Expert	Factor 2: Others	Factor 3:Self	Factor 4: Oppositional	Factor 5: Internet Search	Factor 1: Expert	Factor 2: Others	Factor 3:Self	Factor 4: Oppositional	Factor 5: Internet Search
<i>Internal consistency alpha</i>	0.84	0.90	0.85	0.89	0.91	0.91	0.89	0.84	0.89	0.91
The health professional tell you why to change your behavior?	0.77					0.83				
Ask the health professional what changes to make to your behavior?	0.81					0.85				
The health professional tell you why to change your eating behavior?	0.81					0.84				
Ask the health professional what changes to make to your eating behavior?	0.82					0.85				
Other people tell you why to change your behavior?		0.85					0.79			
Ask family, friends, or work colleagues what changes to make to your behavior?		0.85					0.86			
Other people tell you why to change your eating behavior?		0.87					0.88			
Ask family, friends, or work colleagues what changes to make to your eating behavior?		0.87					0.87			
To determine for yourself why to change your behavior?			0.73					0.77		
Determine for yourself what changes to make to your behavior?			0.82					0.79		
To determine for yourself why to change your eating behavior?			0.82					0.84		
Determine for yourself what changes to make to your eating behavior?			0.80					0.85		
I don't want anyone to tell me why I should change my behavior				0.79					0.75	
I don't want anyone to tell me what changes to make to my behavior				0.86					0.84	
I don't want anyone to tell me why I should change my eating behavior				0.87					0.85	
I don't want anyone to tell me what changes to make to my eating behavior				0.86					0.85	
To do research online about why to change your behavior?					0.82					0.82
Research online about what changes to make to your behavior?					0.87					0.89
To do research online about why to change your eating behavior?					0.88					0.89
Research online about what changes to make to your eating behavior.					0.86					0.89

representative samples. Also, pilot data from around 200 respondents from both countries provided us with initial evidence for the factor structure to be found in the main study. Limitations of the study include its cross-sectional design. Future studies examining the predictive validity of the instrument are encouraged. Moreover, for the specific measure we used the example of dietary change. Whether our findings, which indicated a more global (versus more a context- or behavior-specific) behavior change orientation, would apply to other health behaviors need further research. Similarly, we used hypothetical situations

to classify motivational orientation. It would be useful to test the instrument under actual behavior change conditions, that is, as part of an intervention, to see how the HCOS predicts intervention response. Furthermore, we aimed to include 750 respondents from each country based on a priori power calculations but were only able to include slightly lower numbers (i.e., 603 for US and 737 for NL). This may have led to the study being somewhat underpowered, especially for testing HCOS x Country interaction effects. Also, the study was conducted in December 2020, amid the Covid-19 pandemic. It is difficult to determine

**Table 3**  
Correlations between established measures and HCOS scale items.

Established scales	Factor 1: Expert			Factor 2: Others			Factor 3: Self			Factor 4: Oppositional			Factor 5: Internet Search		
	US	Dutch	Country Interaction p-value	US	Dutch	Country Interaction p-value	US	Dutch	Country Interaction p-value	US	Dutch	Country Interaction p-value	US	Dutch	Country Interaction p-value
Need for Cognition	0.09 *	0.07 *	0.207	0.03	0.03	0.897	0.05	0.12	0.683	-0.09 *	-0.12 *	0.972	0.16	0.12 *	0.282
Desire for involvement in decision making	0.25 ***	0.40 ***	< 0.001	0.44 ***	0.52 ***	0.056	-0.21 ***	-0.20 ***	0.929	-0.16 ***	-0.36 *	0.001	0.09 *	0.13 ***	0.617
Authoritarianism	0.01	-0.05	0.191	0.13	-0.02	0.011	0.07	-0.05	0.059	-0.002	0.005	0.528	-0.07	-0.06	0.504
Reactance	-0.13 **	-0.20 ***	0.037	0.27 ***	0.03	0.001	0.15	0.01	0.033	0.35 ***	0.25 *	0.138	0.15	-0.02	0.006
Autonomous Motivation	0.42 ***	0.28 ***	0.173	-0.03	0.18 ***	< 0.001	0.23	0.38 ***	0.238	-0.19 ***	-0.17 *	0.612	0.17	0.26 ***	0.397
Controlled Motivation	0.11 **	0.20 *	0.086	0.48 ***	0.34 ***	0.051	0.15	-0.08 *	< 0.001	0.13 ***	-0.10 *	< 0.001	0.28 ***	0.15 ***	0.183
Amotivation	-0.12 **	-0.18 ***	0.235	0.34 ***	0.05	< 0.001	0.08	-0.26 ***	< 0.001	0.34 ***	0.24 *	0.068	0.07	-0.13 ***	0.018
SILS	0.08 *	0.07	0.27	-0.35 ***	-0.03	< 0.001	-0.06	0.10 *	0.01	-0.19 ***	-0.04	0.001	-0.10	0.02	0.343
Health literacy	0.14 ***	0.13 ***	0.546	-0.22 ***	-0.05	0.042	0.01	0.16 ***	0.086	-0.10 *	-0.05	0.408	-0.07	0.05	0.204

Note: \* p < 0.05; \*\* p < 0.01; \*\*\* p < 0.001; SILS = Single Item Literacy Screener.

in retrospect whether the responses to the survey were influenced by this situation, but we can imagine that this may have been the case for especially the results related to the HCOS Expert and Internet subscales. We therefore recommend that future research efforts are conducted to apply and test the scale in post-covid times. Finally, the sample was based on two online research panels from two countries with a similar linguistic origin (i.e., Latin). Online samples have been shown to differ from the general population in several ways [27], [28]. For example, our US sample had a slightly lower percentage of non-whites than the US population [29] and the NL sample was relatively lower educated than the Dutch population [30]. Moreover, exclusion rates were unevenly distributed across the two samples, with potential reasons being unclear. This may limit the generalizability of our findings to some extent. Testing the psychometric properties across other countries and cultures – with different linguistic origins – is therefore encouraged, as well as mapping reasons for fast-responding/ response patterns in different samples.

### 4.3. Practice implications

Developing valid, reliable, and generalizable measures is an important first step in developing more deeply tailored and ultimately more effective (digital) health communication. A next step in this line of research would entail developing and testing messages and intervention approaches tailored to individual health communication style preferences. For example, we could test whether web-based interventions are more effective for those scoring high on the HCOS Internet subscale and whether more directive messages are more effective for people scoring high on the HCOS Expert and Others subscales. Likewise, if more autonomy-supportive messages are more effective for the people scoring high on HCOS Self – something for which recent, preliminary evidence was found [12]. Given the automatic nature of computer-tailored technology, tailoring health communication based on HCOS scores might be more easily implemented in a digital context as compared to a face-to-face context, but this is something that needs to be studied further. Moreover, efforts could focus on creating an HCOS short form, facilitating easy and efficient measurement also in face-to-face settings. Finally, we hypothesize that tailoring health communication based on individual health communication style preferences is likely easier and more effectively done when these preferences are assessed specifically in relation to health communication (i.e., using the HCOS) instead of as relatively enduring aspects of personality, as in the GCOS [13]. Whether this hypothesis can be verified, however, is something that would need to be tested in future research.

### 4.4. Conclusion

To conclude, the HCOS subscales have strong psychometric properties, providing a novel approach to assessing communication style preferences for general and patient populations. The HCOS subscales describe five aspects of communication style preferences, i.e., communication orientations towards 1) Experts, 2) Others, 3) Self, 4) Oppositional, and 5) the Internet. Generally, relationships with established measures matched the hypothesized direction of correlation and did not differ significantly between US and NL samples. However, there two were cases where the HCOS subscales and validity measures were in the opposite direction for US and NL samples, both involving the TRSQ controlled motivation scale. This suggest that there may be cross cultural differences in the relationship between controlled motivation, autonomy, and reactance.

### CRedit authorship contribution statement

**Matthias Kirch:** Writing – review & editing, Visualization, Software, Methodology, Investigation, Formal analysis, Data curation. **Eline Suzanne Smit:** Writing – original draft, Software, Project

administration, Methodology, Investigation, Funding acquisition, Conceptualization. **Kenneth Resnicow**: Writing – review & editing, Methodology, Funding acquisition.

### Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

### DATA AVAILABILITY STATEMENT

All data used for the present study is available on the Open Science

Framework ([https://osf.io/t4wxq/?view\\_only=ded51a48595d4389a2c0f1a3eb1b5eb7](https://osf.io/t4wxq/?view_only=ded51a48595d4389a2c0f1a3eb1b5eb7)).

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## Appendix A. Hypothesized correlations with communication style preferences

To explore the construct validity of the HCOS, as reflected by the convergent and divergent validity of the different subscales, we included motivational measures and items about health literacy, that we expected to be negatively, positively, or not correlated to one or more HCOS subscales.

These were our hypotheses (visual overview in Table A1):

First, that need for cognition (NFC) would be negatively associated with external expert orientation and positively associated with self and internet search orientations. The need for cognition represents an individual's tendency to engage in and enjoy effortful cognitive endeavors [31], e.g., thinking about one's options for health related behavior change and actively searching for (more) information about such topic – providing a rationale for our hypothesis that higher need for cognition would be positively associated with autonomous and online search orientations. People scoring relatively higher on external expert orientations, on the other hand, might prefer to rely on someone else (i.e., the expert) to do the thinking and/ or searching, and therefore score lower on NFC.

Second, that the desire for involvement in decision making (related to both health in general and to nutrition specifically) – which was coded such that a higher score represented a lower desire to be involved in decision making – would be positively associated with external expert and external others and negatively associated with self and oppositional orientations, since a higher score for self/ oppositional orientations could suggest a higher need to be actively involved in one's own health-related decision making (i.e., a lower score on the scale) and a higher score for external expert/ others orientations may indicate a lower desire for involvement (i.e., a higher score) [2], [3].

Third, that authoritarianism would be positively associated with external expert orientation and negatively associated with self and oppositional orientations, since high authoritarianism may be an indication that the individual respects and responds to power (e.g., experts) and low authoritarianism represents the opposite of a tendency to not rely on – and even be more oppositional towards – external others [32].

Fourth, that reactance scores would be inversely correlated with external expert orientation and positively correlated with self and oppositional orientations. The positive correlation with oppositional orientations was based on theoretical assumptions about reactance proneness [15], whereas the positive correlation with self orientations was based on the assumption that individuals with a high need for autonomy generally prefer making their own decisions and would therefore report higher levels of reactance when presented with lifestyle behavior associated advice [5] – with the opposite assumed for people scoring higher on external expert orientations.

Fifth, that autonomous motivation would be positively correlated with self and oppositional orientations and inversely correlated with external expert and other orientations. Controlled motivation we hypothesized to be positively correlated with the external expert and other orientations and inversely correlated with self and oppositional orientations. Amotivation was hypothesized to be positively correlated with the amotivation orientation. These expectations were formulated based on theory [33] and previous work into the construct validity of the Virtual Care Climate Questionnaire, a measurement instrument intended to measure support for autonomy in a virtual care setting, in which autonomous motivation was found to more strongly correlate with perceived autonomy-support than controlled motivation [34].

Finally, that health literacy would be negatively associated with external expert and external others and positively associated with self and oppositional orientations. To elaborate, a higher score for self/ oppositional orientations could suggest a higher need to be actively involved in one's own health-related decision making. This desire for active involvement requires adequate health literacy skills to be able to understand one's own health situation [35]. In contrast, higher scores for external orientations may reflect that someone has less health literacy skills, a lower efficacy to be self-determined, and is thus more likely to rely on others for advice.

**Table A1**  
Hypotheses.

	Expert	Others	Self	Oppositional	Internet Search	Amotivation
Need for Cognition	-		+		+	
Involvement in decision making	+	+	-	-		
Authoritarianism	+		-			
Reactance	-		+	+		
Autonomous motivation	-	-	+	+		
Controlled motivation	+	+	-	-		
Amotivation						+
Health literacy	-	-	+	+		



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