

# Instructions for the usage of the Attitude toward Cooperative Industrial Robot Questionnaire (ACIR-Q)

In this short manual the recommended usage of the self-report questionnaire to measure attitudes toward cooperative industrial robots (ACIR-Q) is described. The questionnaire was developed by Benedikt Leichtmann (1), Johanna Hartung (2), Oliver Wilhelm (2) and Verena Nitsch (1) at RWTH Aachen University (1) and Ulm University (2).

## Terms of use:

The questionnaire can be used in its entirety or in part by third parties under the following conditions:

(a) for research purposes the questionnaire can be used free of charge by research institutions. For this purpose, the questionnaire can also be adapted accordingly. If the questionnaire is used for research, the authors of the questionnaire should be quoted as follows in the article in which the results of the research are presented:

Leichtmann, B., Hartung, J., Wilhelm, O., & Nitsch, V. (2020). *Measuring attitudes toward cooperative robots in industrial work settings: Development of a new questionnaire and exploration of attitude structure*. Manuscript submitted for publication.

(b) the questionnaire can also be used by third parties outside of research projects after consultation and approval of the authors. For this purpose please contact:

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## Structure of the questionnaire:

The ACIR-Q contains 12 items to measure attitudes towards cooperative robots and their implementation in industrial work contexts. Four items each reflect the

three factors „affect / behavior“, „social-related beliefs“ and „task-related beliefs“.

Below you will find the assignment of the items to the subfactors.

Item	Negative attitude pole	Positive attitude pole	Subfactor
V1	I generally find the implementation of new robots bad.	I generally find the implementation of new robots good.	Affect / Behavior
S1	I'm afraid of losing my job because of new robots.	New robots will secure my job for the long term.	Social-related Beliefs
S2	New robots make my work increasingly meaningless.	New robots make my work more meaningful.	Social-related Beliefs
S3	With new robots I lose value as a worker.	With new robots I gain in value as a worker.	Social-related Beliefs
S4	Because of new robots I will be less in contact with my colleagues.	Because of new robots I will be more in contact with my colleagues.	Social-related Beliefs
A1	New robots make work processes more opaque.	New robots make the work processes clearer.	Task-related Beliefs
V2	New robots will make my work situation worse.	New robots will improve my work situation.	Affect / Behavior
A2	New robots will lead to worse work results in our company.	New robots will lead to better work results in our company.	Task-related Beliefs
A3	New robots are a new hazard in my workplace.	New robots offer potential for more safety at my workplace.	Task-related Beliefs
A4	New robots will mess up a lot at work.	New robots will lead to more organized work.	Task-related Beliefs
V3	I do not want to have to change my work for a new robot.	I would change for a new robot at work.	Affect / Behavior
V4	I have an uneasy feeling about a new robot.	I am confident about a new robot.	Affect / Behavior

## How to use the questionnaire:

The questionnaire ACIR-Q has been developed mainly to diagnose attitudes of factory workers toward new cooperative robots that are going to be implemented in industrial work contexts. In order to obtain a valid measurement, it is

recommended to communicate a description of the robot to be used, its location and purpose, as well as its capabilities before applying the questionnaire.

In the provided questionnaire a description of a robot is therefore inserted as an example:

*„Imagine that your employer is planning to implement a new robot. As in the figure, this is an automated vehicle with a robot arm (manipulator) that allows the robot to perform tasks such as bin picking or assembly work. For example, it can pick up and transport individual products or assembly parts from the warehouse or assist with assembly tasks. Furthermore, this robot can move independently through the work area and is able to communicate and cooperate with humans.“*

Since attitudes are very context-dependent, this description may have to be adapted to the respective context of use.

## Questionnaire analysis:

For the analysis of the questionnaire, scale means and standard deviations can be calculated for each of the three subscales.

Affect / Behavior = {V1, V2, V3, V4}

Task = {A1, A2, A3, A4}

Social = {S1, S2, S3, S4}

## Questionnaire interpretation:

For questionnaire development and validation, two samples had been used (year of data collection: 2019). One sample was a German-wide online sample derived from an online panel by a market research company including  $N = 355$  workers. For the second sample, data of  $N = 201$  workers from four different Bavarian companies, that planned to implement a new robot in the near future, had been collected at their workplace (field). As response scale a bi-polar 5-point Likert scale [1;5] was used with “1” corresponding to the negative pole and “5” to the positive pole. The higher the value, the more positive the attitude. The workers of the norm sample used the whole scale to answer.

Subfactor		<i>N</i>	<i>M</i>	<i>SD</i>
Affect / behavior	Online	355	3,37	0,92
	Field	201	3,47	0,78
	Total	556	3,41	0,87
Task-related beliefs	Online	355	3,52	0,77
	Field	201	3,39	0,80
	Total	556	3,47	0,78
Social-related beliefs	Online	355	2,81	0,91
	Field	201	2,78	0,85
	Total	556	2,80	0,89

The norm values reported in the table can be used to interpret the values from new data collections.

## Further Information and Contact Information:

Further information can be found on the website [www.robot.psychologie-tests.de](http://www.robot.psychologie-tests.de), as well as in the following publication:

Leichtmann, B., Hartung, J., Wilhelm, O., & Nitsch, V. (2020). *Measuring attitudes toward cooperative robots in industrial work settings: Development of a new questionnaire and exploration of attitude structure*. Manuscript submitted for publication.

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