*Supplement of*

**Learning from the past to inform flood risk management: Analysis of public survey data in Belgium on flood early warning and response during the July 2021 flood**

Heather J. Murdock et al.
*Correspondence to*: Heather J. Murdock (murdock@uni-potsdam.de)

**S1. Questionnaire (English version)**

Hello,
This short survey is aimed at **residents of the places affected by the heavy rain and flood event around July 14, 2021**. Processing the survey should not take more than 10 minutes. Participation in the survey is of course anonymous. The results should help to clarify the warning situation in July 2021 and to improve the warning situation for future events. We therefore ask you to support us with your participation despite the current difficult situation.
Thank you very much!

_____

*Surveys can help to process what has been experienced, but can also lead to the event becoming a burden again. Please seek help in this case. If you need acute psychological help, please contact the support line for psychological support of Wallonia available 7 days a week, 24 hours a day, at: ☎107.*
*You can also consult the website of AVIQ Wallonia "Floods and information for citizens" where you can find a diversity of resources: https://covid.aviq.be/fr/trouver-du-soutien/inondations*

| 1. First of all, we would like to record the situation in your area: To what cause do you attribute the floods to in your immediate area in July? (Multiple choices possible) |
|---|
| ☐ The sewage system could no longer drain the water on the road |
| ☐ Overland water flow from streets or slopes |
| ☐ Water overflow directly from the sewer system via drains, toilets and showers into the rooms below street level (e.g. basement rooms). |
| ☐ Flooding caused by overflowing water bodies (i.e. nearby river or smaller body of water has overflowed) |
| ☐ Flooding as a result of a dike breach or dam breach |
| ☐ Rising groundwater |
| ☐ Other, namely: |
| ☐ I do not know. |
| ☐ My immediate surroundings were not flooded. *(Go to question 3.)* |

| 2. At the maximum water level: How high was the water approximately on the outside of the house? (This means the water level above the surface of the ground) |
|---|
| ☐ There was no water in or around the house. |
| ☐ There was only water in the basement. |
| ☐ Up to 0,5 meters |
| ☐ >0,5 to 1 meters |
| ☐ >1 to 2 meters |
| ☐ >2 to 4 meters |
| ☐ More than 4 meters |

| 3. What is the level of damage to your primary residence due to the floods of July 2021 ? |
|---|
| ☐ Less than 500€ |

- ☐ 500-999€
- ☐ 1.000-4.999€
- ☐ 5.000-9.999€
- ☐ 10.000-24.999€
- ☐ 25.000-49.999€
- ☐ 50.000-74.999€
- ☐ 75.000-99.999€
- ☐ 100.000€-124.999€
- ☐ 125.000€-149.999€
- ☐ 150.000€-174.999€
- ☐ 175.000€ - 199.999€
- ☐ 200.000€ or more

- ☐ No financial damage
- ☐ Not specified

4. Please think back to the hours before the event. How did you find out that the risk of flooding was becoming acute for you? (Multiple choices possible)

- ☐ Severe weather or flood warnings by authorities or on-site disaster response (e.g. fire service, municipality, police)
- ☐ Warning by evacuation call
- ☐ Radio
- ☐ Television (e.g. weather report or teletext)
- ☐ Daily newspaper
- ☐ Weather app
- ☐ Severe weather app (e.g. Katwarn, NINA, Warnwetter App)
- ☐ Siren or loudspeaker truck
- ☐ Self-research on the Internet
- ☐ Social networks on the Internet (e.g. Facebook, Twitter)
- ☐ Through others, e.g. neighbors, acquaintances, colleagues, friends etc. (e.g. personal conversation, phone call, email, WhatsApp)
- ☐ Through my employer
- ☐ Through care or educational institutions (e.g. school, daycare)
- ☐ Other, namely:

- ☐ I do not know.

| | |
|---|---|
| ☐ | I was not made aware of the danger at all / I was not warned. |

| 5. Which of the following information did the warnings contain? (Multiple choices possible) | |
|---|---|
| ☐ | Time for the onset of heavy rain |
| ☐ | Time for the occurrence of the high water or the flooding |
| ☐ | Dangerous areas (place, district, etc.) |
| ☐ | Expected amount of precipitation |
| ☐ | Expected water level (e.g. height of the maximum water level) |
| ☐ | Instructions and recommendations for self-protection (e.g. switch off the electricity, lock windows and doors, do not go into the basement) |
| ☐ | Information about evacuations |
| ☐ | Information about dike or dam breaches |
| ☐ | Assessment of the life-threatening nature of the situation |
| ☐ | Information about diversions, road closures and / or train cancellations |
| | *Continued on next page* |
| ☐ | Information on possible effects, e.g. damage |
| ☐ | Comparison of the expected event with past events / floods |
| ☐ | Other information, namely: |
| ☐ | I do not know. |
| ☐ | None of this information. |

| 6. Approximately when did you receive the first warning? Please include the day and approximate time period that you were warned. | | | |
|---|---|---|---|
| | **Day of the Warning** | | **Time** |
| ☐ | Saturday, 10.07. | ☐ | Before 9:00 in the morning |
| ☐ | Sunday, 11.07. | ☐ | 9:00 to 12:00 |
| ☐ | Monday, 12.07. | ☐ | 12:00 to 15:00 |
| ☐ | Tuesday, 13.07. | ☐ | 15:00 to 18:00 |
| ☐ | Wednesday,14.7. | ☐ | 18:00 to 21:00 |
| ☐ | Thursday, 15.7. | ☐ | After 21:00 |
| ☐ | Friday, 16.17. | | |
| ☐ | I do not know. | ☐ | I do not know. |

| 7. How credible did you think the warnings were? | | | | | | | |
|---|---|---|---|---|---|---|---|
| Not at all credible | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | Completely credible |

| 8. Based on the warnings, how did you assess the severity of the anticipated event? | | | | | | | |
|---|---|---|---|---|---|---|---|
| It will rain, but that is not a problem. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | There is a storm with extensive flooding, damage and life-threatening situations. |

| 9. Did you know how you can protect yourself and your household from flooding before the risk of flooding became acute for you? | | | | | | | |
|---|---|---|---|---|---|---|---|
| It was completely unclear to me. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | It was perfectly clear to me. |

10. When you became aware of the risk of flooding, what did you do? (Multiple choices possible)

- ☐ I went about my daily activities without paying attention to the event.
- ☐ I informed others (e.g. friends, acquaintances, family) or helped them.
- ☐ I researched information about heavy rain and / or floods.
- ☐ I took measures to reduce the damage (e.g. secure documents and valuables, put furniture up, erected water barriers).
- ☐ I turned off electricity / gas in my house.
- ☐ I went to a safe place.
- ☐ I got help.
- ☐ I prepared for an evacuation and packed up important documents and things.
- ☐ Other, namely:

- ☐ I do not know.

11. How badly was **your place of residence** affected by the heavy rain or flood event?

| Not affected at all | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | Very badly affected |
|---|---|---|---|---|---|---|---|

12. How badly was **your household** affected by the heavy rain or flood event?

| Not affected at all | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | Very badly affected |
|---|---|---|---|---|---|---|---|

13. What do you estimate: How much were you able to reduce damage through your reaction to the event and / or private preventive measures? *

| Not at all | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | Almost completely |
|---|---|---|---|---|---|---|---|
| | | | | | | ☐ | I do not know. |

** Private precautionary measures include, for example, the use of flood-adapted building and construction materials, the installation of flood-proof heating, the purchase of pumps or water barriers, etc.*

14. How surprising did you find the severity of the event in your immediate vicinity?

| The severity of the event didn't surprise me at all. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | The severity of the event totally surprised me. |
|---|---|---|---|---|---|---|---|

15. How often have you personally - before July 2021 - been damaged by floods?

| | |
|---|---|
| ☐ Never before | ☐ Three times |
| ☐ Once | ☐ Four times |
| ☐ Twice | ☐ More than four times |

- ☐ Not specified

| 16. When was the last time you were affected by a flood (before July 2021)? | |
|---|---|
| Year: | Month: |

| 17. To conclude, we would like to come back to the warning situation. Many options for adapting the warnings are currently being discussed. | | | | | | |
|---|---|---|---|---|---|---|
| How helpful do you think the following measures are? | Not helpful at all | | | | | Very helpful |
| Cell broadcasting, i.e. automatic sending of a warning to all cell phones in a certain region without prior registration | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Warning messages via SMS or APP with prior login / registration | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Comprehensive installation of sirens | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Increased reporting on severe weather and / or flood warnings and correct conduct in the media (radio, television) | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

| 18. How important is it to you that the following information is included in severe weather warnings? | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Not important | | | | | Very important | I do not know |
| Time for the onset of heavy rain | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Time for the occurrence of the high water or the flooding | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Dangerous areas (place, district, etc.) | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Expected amount of precipitation | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Expected water level (e.g. height of the maximum water level) | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Instructions and recommendations for self-protection (e.g. switch off the electricity, lock windows and doors, do not go into the basement) | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Information about evacuations | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Information about dike or dam breaches | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Assessment of the life-threatening nature of the situation | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Information about diversions, road closures and / or train cancellations | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Information on possible effects, e.g. damage | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Comparison of the expected event with past events / floods | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Other information, namely: | | | | | | | |

| 19. In order to be able to make statements about what the warning situation looked like for people in the different affected regions of Germany, it is important that we know where most of them live. Therefore, please enter your postcode and place of residence. |
|---|

| | |
|---|---|
| Postcode: | Location: |

| |
|---|
| 20. How old are you? |
| _____ Years old |

| | | | |
|---|---|---|---|
| 21. Are you...? | | | |
| O female | O male | O other | O not specified |

| |
|---|
| 22. How many people live in your household at all times, including yourself and all the children? |
| _____ People |

| |
|---|
| 23. Do you have any further comments? |
| |

**Thank you for your participation!**

Thank you very much for taking your time for this survey. We wish you personally and the whole region a lot of strength for the reconstruction. If you have any questions, please contact: extrass@uni-potsdam.de

**S2. Additional Regression Tables**

Additional tables with regression model results not included in the body of the paper are provided here. First Model 2.1 (Table S1) is included with the same explanatory variables and the addition of age as an explanatory variable. A difference version of Model 4.1 is included (Table S2) with one explanatory variable changed from BAI1 to BAI2.

**Table S1:** Results of a linear regression with credibility as predictor variable (n = 281)

| **Explanatory variable** | **Coefficient (Unstandardized B)** | **Standard Error** | **p** | **95% conf. interval** | |
|---|---|---|---|---|---|
| Age | -0.002 | 0.007 | 0.829 | -0.015 | 0.012 |
| Gender | -0.057 | 0.045 | 0.209 | -0.146 | 0.032 |
| Household Size | -0.019 | 0.071 | 0.788 | -0.159 | 0.120 |
| Flood Experience | -0.055 | 0.090 | 0.543 | -0.232 | 0.122 |
| Warning Source Indicator (WSI) | -0.024 | 0.087 | 0.787 | -0.196 | 0.148 |
| Warning Information Indicator (WII) | -0.056 | 0.076 | 0.460 | -0.206 | 0.094 |
| _Constant | 3.686 | 0.515 | 0.000 | 2.673 | 4.699 |

$R^2$ = 0.010, Adjusted $R^2$ = -0.011

**Table S2:** Results of a linear regression model with perceived effectiveness of damage reducing measures as an outcome variable (n=265)

| **Explanatory variable** | **Coefficient (Unstandardized B)** | **Standard Error** | ***p*** | **95% conf. interval** | |
|---|---|---|---|---|---|
| Age | -0.003 | 0.006 | 0.566 | -0.014 | 0.008 |
| Gender | -0.040 | 0.038 | 0.283 | -0.114 | 0.034 |
| Flood Experience (prior to 2021) | 0.015 | 0.075 | 0.837 | -0.132 | 0.163 |
| Warning Source Indicator (WSI) | 0.063 | 0.073 | 0.386 | -0.080 | 0.207 |
| Warning Information Indicator (WII) | -0.038 | 0.065 | 0.563 | -0.167 | 0.091 |
| Expected Severity | 0.045 | 0.058 | 0.435 | -0.069 | 0.159 |
| Situational Knowledge | 0.212 | 0.052 | 0.000 | 0.111 | 0.314 |
| Behaviour Action Indicator (BAI2) | 0.123 | 0.083 | 0.139 | -0.040 | 0.286 |
| Water Level | -0.210 | 0.057 | 0.000 | -0.323 | -0.097 |
| _Constant | 2.317 | 0.498 | 0.000 | 1.335 | 3.298 |

$R^2$ = 0.161, Adjusted $R^2$ = 0.131

**S3. Variables Tables**

**Table S3:** Summary table of variables used for logistic and linear regression models

| Classification | Variable | Variable Code Question Nr. | Survey Question | Definition / Scale | Distribution of the Data | Previous Studies |
|---|---|---|---|---|---|---|
| Target variable Model 1.1 | Officially Warned (n=550) | dummy_wsi34 Based on Q4 | Please think back to the hours before the event. How did you find out that the risk of flooding was becoming acute for you? | [0] not officially warned<br>[1] officially warned | [0] 72.2%<br>[1] 27.8% | (Thieken, 2005), (Thieken, 2023), (Heidenreich, 2025) |
| Target variable Model 2.1 | Credibility (n=346) (filtered variable) | W008_01 Q7 | How credible did you think the warnings were? | [1] not at all credible<br>[6] credible | [1] 20%<br>[2] 11%<br>[3] 26%<br>[4] 18%<br>[5] 12%<br>[6] 13% | Expert status of information source plays a role, clear messages play a role, repetition of consistent messages positively influence credibility (Mileti, 1994)<br>Local knowledge plays a role, false positives erode credibility (Blösch, 2010), (Parker and Priest 2012)<br>Risk perception and experience plays a role (Bradford, 2012) |
| Target variable Model 2.2 & Explanatory Variable | Situational Knowledge on Protective Behaviour (n=538) | W010_01 Q9 | Did you know how you can protect yourself and your household from flooding before the | [1] It was completely unclear to me<br>[6] It was perfectly clear to me | [1] 42.0%<br>[2] 18.0%<br>[3] 14.7%<br>[4] 10.8% | Situational awareness during the 2021 flood in Germany (Zander, |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | risk of flooding became acute for you? | | [5] 6.1%<br>[6] 8.4% | 2021) and (Thieken, 2023) |
| Target variable Model 2.3 | Perceived Surprise (n=545) | W016_01 Q14 | How surprising did you find the severity of the event in your immediate vicinity? | [1]The severity of the event didn't surprise me at all<br>[6]The severity of the event totally surprised me | [1] 1.1%<br>[2] 1.1%<br>[3] 1.5%<br>[4] 3.7%<br>[5] 16.0%<br>[6] 76.7% | Surprise and the 2021 flood in Germany (Thieken, 2023), surprise and the 2021 in Belgium (Rodríguez Castro et al., 2025a) |
| Target variable Model 3.1 & Explanatory Variable | BAI1 Behavioural Response: Protective Response - Damage Reducing | W011_01 to 09 Based on Q10 | When you became aware of the risk of flooding, what did you do? | [0] No Action<br>[1] Information Exchange / Preparation<br>[2] Protective Response: Life Saving Measures<br>[3] Protective Response: Damage Reducing Measures | [0] 11.6%<br>[1] 15.8%<br>[2] 18.5%<br>[3] 54.0% | Protective behaviour (Lindell and Perry, 2012), (Terpstra and Lindell, 2013), |
| Target variable Model 3.2 & Explanatory Variable | BAI2 Behavioural Response: Protective Response - Life Saving | W011_01 to 09 Based on Q11 | | [0] No Action<br>[1] Information Exchange / Preparation<br>[2] Protective Response: Damage Reducing Measures<br>[3] Protective Response: Life Saving Measures | [0] 11.6%<br>[1] 15.8%<br>[2] 20.0%<br>[3] 52.5% | |
| Target variable Model 4.1 | Perceived Damage Reduction (n=534) | W014_01 Q13 | What do you estimate: How much were you able to reduce damage through your reaction to the event and / or private preventive measures? | 1 = Not at all<br>6 = Almost completely | [1] 51%<br>[2] 17%<br>[3] 14%<br>[4] 10%<br>[5] 4%<br>[6] 3% | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Target variable Model 4.2 | Damage | W023 Q3 | What is the level of damage to your primary residence due to the floods of July 2021 ? | [1] Less than 500<br>[2] 500-999<br>[3] 1.000-4.999<br>[4] 5.000-9.999<br>[5] 10.000-24.999<br>[6] 25.000-49.999<br>[7] 50.000-74.999<br>[8] 75.000-99.999<br>[9] 100.000-124.999<br>[10] 125.000-149.999<br>[11] 150.000-174.999<br>[12] 175.000 - 199.999<br>[13] 200.000 or more | [1] 3.2%<br>[2] 2.2%<br>[3] 4.8%<br>[4] 6.5%<br>[5] 9.7%<br>[6] 11.4%<br>[7] 14.7%<br>[8] 12.7%<br>[9] 11.4%<br>[10] 8.4%<br>[11] 4.1%<br>[12] 3.5%<br>[13] 7.3% | Damage during the 2021 flood in Germany (Burghardt et.al., 2024), in Belgium (Rodríguez Castro et al., 2025b) |
| Explanatory variable | Age (n=527) | SD02_01 Q20 | How old are you? | Age given numerically | [16-20 years] 0.8%<br>[21-40 years] 24.1%<br>[41-60 years] 45.5%<br>[61-80 years] 28.1%<br>[>80 years] 1.7% | Age and barriers to protective behaviour (Cong et al., 2021; Dostal, 2015), age and disaster preparedness (Cong et al., 2021), age and damage (Rodríguez Castro et al., 2025b) |
| Explanatory variable | Gender (n=507) | c_SD03 Q21 | Gender: | [1] Woman<br>[2] Man | [1] 56%<br>[2] 44% | Gender and flood warning and response (Cvetković et al., 2018; Thieken et al., 2023b) |

| | | | | | | |
|---|---|---|---|---|---|---|
| Explanatory variable | Household size (n=522) | SD06_01 Q22 | How many people live in your household at all times, including yourself and all the children? | Numeric answer 1 to 10 | [1] 21.5%<br>[2] 36.8%<br>[3] 18.2%<br>[4] 14.4%<br>[5] 5.2%<br>[6] 2.3%<br>[7] 1.3%<br>[8] 0.2%<br>[9] 0.0%<br>[10] 0.2% | Household size and pluvial flood reponse behaviour (Rözer et al., 2019), household size and life saving behaviour (Soon et al., 2018; Liu et al., 2024) |
| Explanatory variable | Flood Experience (prior to 2021) (n=541) | W017 Q15 | How often have you personally - before July 2021 - been damaged by floods? | [1] Never before<br>[2] Once<br>[3] Twice<br>[4] Three times<br>[5] Four times<br>[6] More than four times | [1] 75.1%<br>[2] 10.4%<br>[3] 5.8%<br>[4] 2.9%<br>[5] 1.6%<br>[6] 2.5% | Flood experience and risk perception (Siegrist and Gutscher, 2008; Terpstra and Lindell, 2013; Botzen et al., 2015; Kuller et al., 2021), Flood experience and overconfidence (Wachinger et al., 2013) |
| Explanatory variable | Flooded Water Level (n=517) | W003 Q2 | At the maximum water level: How high was the water approximately on the outside of the house? | [1 ] There was no water in or around the house.<br>[2] There was only water in the basement.<br>[3] Up to 0,5 meters<br>[4] >0,5 to 1 meters<br>[5] >1 to 2 meters<br>[6] >2 to 4 meters<br>[7] More than 4 meters | [1] 4%<br>[2] 5%<br>[3] 5%<br>[4] 10%<br>[5] 40%<br>[6] 32%<br>[7]5% | Water level and damage during the 2021 flood in the Walloon Region (Rodríguez Castro et al., 2025a, Rodríguez Castro et al., 2025b) |

| | | | | | | |
|---|---|---|---|---|---|---|
| Explanatory variable | Expected Severity (n=350) | W009_03 Q8 | Based on the warnings, how did you assess the severity of the anticipated event? | [1] It will rain but it is not a problem<br>[6] There's a storm with extensive flooding, damage, and life-threatening situations | [1] 9.6%<br>[2] 9.6%<br>[3] 16.0%<br>[4] 15.1%<br>[5] 5.1%<br>[6] 8.2% | Severity, threat appraisal, and protective behaviour behaviour (Kuhlicke et al., 2020; Grothmann and Reusswig, 2006) |
| Explanatory variable | Municipality Affectedness Level (n=550) | Based on SD01_01 Based on Q19 | Postcode: | [0] Not affected<br>[1] Most affected<br>[2] Very affected<br>[3] Affected | [0] 17.8%<br>[1] 67.5%<br>[2] 9.5%<br>[3] 5.3% | Community level affectedness (Rodríguez Castro et al., 2025a) |
| Explanatory variable | Perceived Impact (Household) (n=544) | W013_01 Q12 | How badly was your household affected by the heavy rain or flood event? | [1] Not at all affected<br>[6] Very affected | [1] 3.9%<br>[2] 5.0%<br>[3] 4.8%<br>[4] 13.4%<br>[5] 21.7%<br>[6] 51.3% | Household vs community impact in Belgium during 2021 event (Rodríguez Castro et al., 2025a), in the Netherlands during the 2021 event, (Endendijk et al., 2023), in Germany during the 2021 event (Thieken, 2023, Heidenreich, 2025) |
| Explanatory variable | Perceived Impact (Community) (n=546) | W012_01 Q11 | How badly was your place of residence affected by the heavy rain or flood event? | [1] Not at all affected<br>[6] Very affected | [1] 6.4%<br>[2] 6.8%<br>[3] 5.7%<br>[4] 13.0%<br>[5] 20.9%<br>[6] 47.3% | Community level affectedness (Rodríguez Castro et al., 2025a) |
| Explanatory variable | WSI (n=550) | wsi W004_01 to W004_15 Based on Q4 | Please think back to the hours before the event. How did you find out that the risk | [0] no warning<br>[1] own search<br>[2] friends or neighbours | [0] 33%<br>[1] 17%<br>[2] 22% | (Thieken, 2005), (Thieken, 2023), (Heidenreich, 2025) |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | of flooding was becoming acute for you? | [3] national news<br>[4] warning issued by authorities | [3] 7%<br>[4] 21% | |
| Explanatory variable | WII (n=495) | W007_01 to W007_13<br>Based on Q5 | Which of the following information did the warnings contain? | [0] no warning/no relevant information<br>[1] organizational information<br>[2] information on timing and intensity of rainfall<br>[3] information on the impacts of rainfall<br>[4] information on how to behave and protect oneself and/or information on the life-threatening situation | [0] 49.1%<br>[1] 2.0%<br>[2] 29.3%<br>[3] 3.2%<br>[4] 16.4% | (Thieken, 2005), (Thieken, 2023), (Heidenreich, 2025) |
| Explanatory variable | Surprise Effect Indicator (n=531) | SEI<br>Based on spatial analysis | Indicator related to flooded areas during 2021 outside of official hazard maps | Scale of 0 to 7.82 | | Used in (Rodríguez Castro et al., 2025a) |

**Table S4:** Warning Source Indicator Coding Table

| WSI | Criteria |
|---|---|
| **4 = warning issued by authorities** | • Severe weather or flood warnings by authorities or on-site disaster response (e.g. fire service, municipality, police)<br>• Warning by evacuation call<br>• Severe weather app on your mobile phone<br>• Alert tool (e.g. BE-Alert)<br>• Siren or loudspeaker truck |
| **3= national news** | • Radio<br>• Television (e.g. weather forecast or teletext)<br>• Daily newspaper |
| **2 = friends or neighbours** | • Social networks on the Internet (e.g. Facebook, Twitter)<br>• Through other people, e.g. neighbours, acquaintances, colleagues, friends, etc. (e.g. personal conversation, telephone call, e-mail, WhatsApp)<br>• Through my employer<br>• Through childcare or educational facilities (e.g. school, nursery) |
| **1 = own search** | • Self-research on the Internet<br>• Personal observation (further categorised) |
| **0 = no warning** | • I was not made aware of the danger at all / I was not warned. |
| **(-1) Missing value** | • Other, for example<br>• I do not know |

**Table S5:** Warning Information Indicator Coding Table

| WII | Criteria |
|---|---|
| **4 = information on how to behave and protect oneself and/or information on the life-threatening situation** | • Instructions and recommendations for self-protection (e.g. switch off the electricity, lock windows and doors, do not go into the basement)<br>• Assessment of the life-threatening nature of the situation<br>• |
| **3= information on the impacts of rainfall** | • Information on possible effects, e.g. damage<br>• Comparison of the expected event with past events / floods |
| **2 = information on timing and intensity of rainfall etc** | • Time for the onset of heavy rain<br>• Time for the occurrence of the high water or the flooding<br>• Dangerous areas (place, district, etc.)<br>• Expected amount of precipitation<br>• Expected water level (e.g. height of the maximum water level)<br>• Information about dike or dam breaches |
| **1 = organizational information** | • Information about evacuations<br>• Information about diversions, road closures and / or train cancellations |
| **0 = no warning/no relevant information** | • None of this information |
| **Missing value** | • Other, for example<br>• I do not know |

10