

## ***Interactive comment on “The street, an area exposed to earthquakes (the Lorca case, Spain 2011)” by M. B. Rojo et al.***

### **Anonymous Referee #2**

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Overall the article presents a very thought-provoking study that could prove very useful in future evacuation and crisis management situations if presented properly. However, there are several weak spots that deserve to be improved.

Section 1: The authors do not seem to be very familiar with the language of earthquake science in English (I have included a list with some mistakes I spotted in the joint pdf). For example, the words "seism" and "paraseismic" are rarely used in the field. I recommend using "quake/earthquake" and "earthquake-resistant" instead. Another example: in line 37 the authors use the expression "maximum acceleration" and I think they probably mean Peak Ground Acceleration, which is a technical term. The Lorca event is also presented in a very muddled way: there is no overview of the seismotectonic context in South-Eastern Spain that originated the earthquake, for one. I also reckon that, for an article that looks so closely at the event timeline, it would be good to include a

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timeline of foreshocks and aftershocks within the studied time period early on in the introduction, since this can be a good guide for the reader. The aftershocks appear with barely any explanation in Figure 7, and one would think strong aftershocks would be motivators for changes in behavior. The conclusion in Lines 43/44 is also confusing due to this lack of seismological context: shallow earthquakes often attenuate quickly with distance, and that's why there was little damage beyond a short distance from Lorca.

Section 2: This section could be shorter and more to the point. I am not certain that Lines 64 to 94 are very relevant to the rest of the article: comparisons to the situation/the types of buildings in Lorca are not directly drawn. The comparison to the Liege earthquake is more interesting. The authors should concentrate on identifying other cases where people were hurt/killed while on the street. An important missing reference is the HAZUS – MH MR5 Loss Estimation Methodology, which explicitly considers both indoors and outdoors population by type of building and time of day. As to people's behavior during the earthquake, I recommend the literature review in the PhD thesis by ES Lambie (Human response to Earthquake Shaking: Analysis of video footage of the 2010-2011 Canterbury earthquake sequence). Line 123 says the collapsed building in Lorca did not cause any victims: could the authors say why? Paragraph 2.3 is titled "Exposure VS Social vulnerability", but doesn't address social vulnerability, I think the authors mean personal vulnerability. In any case, I think it would be more interesting if they analyzed the relationship between exposure and occupancy in more depth, occupancy being the location of the population inside/outside of buildings due to their occupation and time of day. Lines 145 to 167 are very interesting, and represent the core innovation of this article: I recommend moving these to section 3 in the Analysis Methodology.

Section 3: As another reviewer pointed out, this section is incomplete because parts of the methodology are presented in Section 4. Line 205 seems to contradict the definition of "evacuation" given in paragraph 2.3. More information on the 20 people interviewed

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would be welcome: since the focus of this article is injury while on the street, were any of these people injured? Did they move exclusively on foot or did they use cars? Did they journey alone or were they part of a group? The expression “all individuals walk in the same places” in Line 262 implies that the persons were on foot, but the description of traffic jams in Line 236 implies they used cars. Access to a car seems like it would have a big impact on the length and number of journeys, but this is not mentioned in the discussion in Lines 452 to 463. Data for the reasons of movement is gathered but not discussed in Section 4. Furthermore, it is unclear how the area of “evacuation” was delimited in Line 511: a map that shows the exact limits considered in the QGIS cartography would be good. Maybe add the limits to Figure 2. Did the authors compare their perimeter with the levels of earthquake intensity? Otherwise, it is difficult to justify the assumption that one is safe outside of Lorca (Line 266 and Line 514).

Section 4: The evaluation of impacted areas from photographs and videos is an interesting approach and could be used in the future for safety recommendations. It would be good to include a map that localizes the collected photos and the analyzed buildings. The numbers presented in Lines 423 to 437 are however difficult to interpret without giving more context as to the intent of the subjects when they made those trips. It would also be good to evaluate behavior when the individuals were moving through “exposure sections”: where they aware that they were in a dangerous zone? Did they travel more quickly or try to avoid these paths? Where were the people’s homes relative to these sections? Since the people made several trips between buildings; a further question is raised: at what point did the people decide to leave Lorca? Was there an official call for evacuation? If there was, it should be included in Figure 7 together with the notable aftershocks, as it may also have altered behaviors. Again, the use of the term “evacuation” in this Section does not fully line up with the definition given in paragraph 2.3. Figure 7 is interesting, but I felt grouping all the individuals together did not give the full picture: I suggest you add a figure similar to Figure 2 where you plot a single person’s journey. The conclusion in Line 572 about the exposure levels inside and outside buildings is dubious: if people had remained inside the one building that

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collapsed, surely they would have become casualties. Stepping outside reduced their exposure.

Section 5: The conclusion about improving information on how to behave after an earthquake is very good and is one of the stronger points of this article. I suggest the authors make some recommendations of their own based on their findings (for example, a safety distance to maintain from buildings of 6m during evacuation). Lines 603 to 621 are less clear: evolutions in seismic zonation do not mean that the hazard has increased, but rather that it is better understood. Furthermore, Line 611 refers to the phenomenon by which infilled concrete frame structures can accelerate collapse in case of earthquake because the structure doesn’t behave as planned. I’m not sure this is relevant to this study, which is centered on how non-structural elements (cornices, infills, facade elements) can lead to injury even if the buildings do not collapse.

Please also note the supplement to this comment:

<http://www.nat-hazards-earth-syst-sci-discuss.net/nhess-2016-115/nhess-2016-115-RC2-supplement.pdf>

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