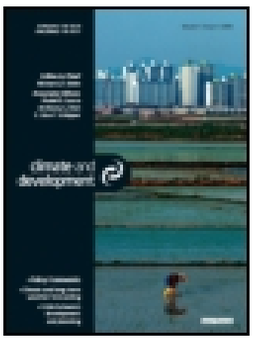

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RESEARCH ARTICLE

# Mainstreaming risk reduction into self-build housing: the negligible role of perceptions

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This article unpacks the relationship between risk perceptions and responses in cities of the global south. It first challenges the assumption that people are irrational and/or lack the ability to comprehend risk when they do not prioritize risk reduction. Second, it argues that the nature of risk perceptions has less direct influence on responses than previous research suggests. A social constructivist approach is applied to explore how individuals process risk and to what extent these perceptions shape preparedness activities. Results are based on ethnographic research in Cochabamba city in Bolivia, where everyday climatic hazards are linked to slow-onset and small-scale impacts. Findings first suggest that people comprehend risk in sophisticated ways. Then through exploration of self-build housing and the adoption of an anthropocentric conceptualization of the house, the article shows that people with high- and low-risk perceptions equally prepare for the impacts of climatic hazards. This is because people prioritize the transformation and consolidation of social, cultural and economic processes which are not directly related to risk reduction when designing and constructing self-built houses. However, disaster risk reduction is automatically mainstreamed into housing because the design and construction features which people associate with risk reduction represent local architectural norms that are associated with 'good practice'.

**Keywords:** climate risk; global south; risk perception; mainstreaming; self-build housing

## 1. Introduction

Over the last 20 years, 90% of major disasters have been caused by 6457 recorded floods, storms, heatwaves, droughts and other weather-related events (UNISDR, 2015). Weather and climate are major drivers of disaster risk and, although impacts of climate change are experienced globally, it is widely accepted that developing countries are the most vulnerable to climatic hazards (Ayers & Dodman, 2010; IPCC, 2014; Schipper, 2007). More specifically, increasing climatic hazards, such as longer periods of rainfall and rising temperatures, coupled with high levels of poverty and weak institutional frameworks to address related impacts make certain populations in the global south most at risk to climate-related disasters (Bicknell, Dodman, & Satterthwaite, 2012; Cannon & Muller-Mahn, 2010).

The relationship between the risk perceptions and responses of those most at risk remains unclear and research is often contradictory. On top of this, there is a relatively small body of research that explores this relationship in the global south, as most research focuses on global north settings. In this area, some studies show that higher risk perceptions catalyse risk-reducing action (Grothmann & Reusswig, 2006; Heitz, Spaeter, Auzel, & Glatron, 2009). Conversely, other research argues that people with high-risk perceptions seldom take any action to reduce their risk because of fatalism, or an overwhelming sense of fear or because they lack the capacity to address their risk (Haynes, Barclay, & Pidgeon, 2008; Hall & Slothower, 2009; Jóhannesdóttir & Gísladóttir, 2010). Equally, low-risk perceptions have also been associated with a lack of engagement with risk-reduction actions because people underestimate impacts or prioritize other risks and objectives (Barberi, Davis, Isaia, Nave, & Ricci, 2008; DFID, 2005; IFRC, 2014; Shepherd et al., 2013).

The World Disaster Report (IFRC, 2014) highlights that organizations and academics working on DRR[1] often make an assumption that at-risk populations in the global south want to take action and prioritize the minimization of potential impacts. Problematically, this imposition of a scientific logic opens up the space for an interpretation of vulnerable people as irrational or lacking the ability to comprehend risk if they do not engage in risk-reduction activities (Cannon, 2008; IFRC, 2014; Jóhannesdóttir & Gísladóttir, 2010; Lewis, Kelman, & Lewis, 2011). As a result, a narrative is constructed of a need for disaster managers who are implied to have the objective and scientific abilities to comprehend disaster risk and reduce it on behalf of vulnerable people (Hajer & Versteeg, 2005). Subsequently the pendulum swings towards a technocratic

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approach that is informed by an unbounded faith in the ability of disaster managers to apprehend and transform the world. Thus top-down interventions, which marginalize the perspectives, skills and agency of those most immediately affected by hazards, are prioritized (Felli & Castree, 2012; Hajer & Versteeg, 2005). There is also an emphasis on vertical communication of risk information because it is assumed that people will change their behaviour and prepare for the impacts of hazards when educated about risk, despite several studies on health (Marteau & Kinmouth, 2002) and climate change disputing this assumption (see van der Linden, 2014 cited in IFRC, 2014).

Within the literature on risk perceptions and responses, there is a tendency to exclusively explore this relationship through disaster risk vernacular and analyses. In other words, broader social, cultural and economic processes that may not be directly related to issues of risk are often overlooked when explaining people's social experiences of risk (Cannon, 2008). There is also a tendency to focus on infrequent and rapid-onset natural hazards that are linked to large-scale disasters (e.g. Gierlach, Belsher, & Beutler, 2010; Heitz et al., 2009; Jóhannesdóttir & Gísladóttir, 2010; Motoyoshi, 2006; Takao et al., 2004). Furthermore, there is also a dearth of studies that directly link perception with preparedness activities as most concentrate on human behaviour in the aftermath of impacts (Chester, Duncan, Wetton, & Wetton, 2007).

In light of this background, this article applies a social constructivist approach to tackle two closely related questions. Firstly, how do people perceive their risk of the impacts of climatic hazards? Secondly, to what extent do these perceptions shape the way individuals prepare for the impacts of climatic hazards? Focus is on preparedness activities to the impacts of everyday[2] climatic hazards that are linked to slow-onset small-scale disasters, which offers a largely unexplored setting in this field. Through these questions the paper aims to critically unpack the assumption that it is people's priority to minimize the impacts of hazards – climatic or otherwise. It also aims to increase understanding of how individuals process risk and prepare for the impacts of climatic hazards. Results are based on ethnographic research in three neighbourhoods in Cochabamba city in Bolivia. This includes nine months of fieldwork in 2012/2013, and two week return visits in 2014 and 2015.

The article takes a novel approach to trace this relationship by focusing on the process of self-building housing as the site of analysis. In particular, the study explores to what extent risk perceptions influence people to (re)construct houses in order to prevent the impacts of climatic hazards. To facilitate this, an anthropocentric conceptualization of the house is adopted. This implies that the house is more than a physical resource for shelter or to accumulate assets[3] in order to reduce vulnerability. Rather the house is viewed as a resource to transform and facilitate a diversity of social, economic and cultural processes that may or may not be directly related to risk reduction. This allows the research to identify the underlying and often hidden mechanisms that influence and catalyse the self-build housing process.

Through this approach, the article shows that the nature of an individual's risk perception has a negligible role to play, which challenges the mainstream position in this area of work. People with high and low-risk perceptions equally (re)construct their house in ways that reduce the impacts of climatic hazards. This is because disaster preparedness is considered good architectural practice, and so risk-reduction construction features are mainstreamed into the design of the house. Further, an anthropocentric understanding of the house allows the article to show that the self-build housing process is principally catalysed and influenced by the transformation of broader social, cultural and economic processes, rather than risk reduction. In particular, people place great emphasis on expressing personal taste, and increasing public social status, economic security, privacy, health, comfort and efficient domesticity when deciding how to (re)construct their house. However, through the pursuit of these objectives, people automatically integrate disaster preparedness.

With regard to the formation and characteristics of risk perceptions, people understand risk in more sophisticated ways than is often asserted in academic literature. In particular, people do not perceive that their future levels of risk are generally abstracted from their everyday lives. Instead their perceptions have a long-term temporality, as they understand that their risk can increase incrementally with the persistent impacts of rainfall and if vulnerability is not reduced. Second, people understand that risk is not a natural process; rather, people perceive that risk is internal to human action and so can be reduced. These findings are largely explained by looking to the nature of everyday climatic hazards that are linked to slow-onset small-scale disasters.

## 2. Risk perceptions and social experiences of risk

Sjöberg, Moen, and Rundmo (2004) define a risk perception as an individual's assessment of the probability of a particular event occurring and how concerned a person is with the consequences. It is constituted by an individual's understanding of, and ability to cope with signals about dangers, vulnerabilities and uncertainties. The theoretical approach one adopts determines what factors are considered the most influential when a person interprets these signals. There are two broad approaches for studying risk perceptions – realist approaches and constructivist approaches (Wachinger, Renn, Begg, & Kuhlicke, 2013). They allow one to understand the formation of risk perceptions and to identify people's social experiences of risk. Therefore, they provide the basis for understanding how and why people respond to risk (Shreve et al., 2014).

### 2.1. *The 'reality' of risk*

The realist position asserts that there is an objective reality that is ultimately knowable through empirical investigation. 'Objective'[4] risks are seen as independent properties of the environment that can be identified and measured (Wachinger et al., 2013). An underlying premise of this position is the view that scientific knowledge is essentially neutral, unproblematic stuff, concerned with truth about the physical world. Accordingly people can recognize and understand their risk using their cognitive processes (Fischhoff, Slovic, Lichenstein, Read, & Combs, 1978; Slovic, 2000). In this way, human beings are said to calculate their risk based on the nature of 'objective' risk, and in isolation from other broader social and cultural factors that may influence their perceptions of risk (Johnson & Tversky, 1983).

Realist approaches to risk perceptions are closely associated with rational actor theories of human behaviour, which provide an explanatory framework for understanding social responses to risk. Examples include 'behavioural decision theory' (Starr, 1969), 'value expectancy models' (Weinstein & Nicolich, 1993) and 'knowledge, attitudes, behaviour models' (McGuire, 1989). They assert that humans are purposive and goal-oriented agents that seek to maximize individual utility (humans select actions that lead to more personal satisfaction). Therefore, human behaviour is predictable if people's preferences are known. As such, rational actor theory is descriptive because it identifies how people select and justify their behaviour, and it is also normative because it provides a model of how people should behave. Within 'risky' settings, these models suggest that people will prioritize the minimization of risk reduction.

Coupled with realist interpretations of risk perceptions, there is a supposed linear relationship between 'objective' risk, individual risk perceptions and human responses (Wachinger et al., 2013). For example, this approach asserts that if an individual is at high (objective) risk of a flood, their risk perception should perfectly mirror this and also be high, and they should subsequently engage in behaviours to reduce their risk of flooding. Studies that apply this approach frequently argue that there is a 'paradox' because individuals with high-risk perceptions regularly do not act to reduce their risk. Explanations include fear, which is said to overwhelm people's ability to act or can induce passivity and fatalism (Hall & Slothower, 2009; Jóhannesdóttir & Gísladóttir, 2010). In contrast, denial may protect an individual from the unpleasantness of fear in which they simply refuse to believe in such a reality (Lewis et al., 2011). Further, people may have 'normalization bias', or what is sometimes called 'the illusion of invulnerability', whereby people believe they are less likely to be harmed by hazards than other people, or they underestimate the impacts of hazards, even if they believe that they will experience a negative event (Paton, Smith, & Johnston, 2000).

Therefore, when people do not engage in, or prioritize risk reduction they are said to have a 'bounded rationality' whereby 'behaviour is generally rational or logical but is limited by perception and prior knowledge' (Tobin & Montz, 1997, p. 5). This makes them 'unintentional risk takers' (Douglas, 2013, p. 13). Accordingly, the solutions to 'inaccurate' perceptions and 'irrational' behaviours are to provide people with more information about risk and how to reduce it (e.g. Eisenman, Cordasco, Asch, Golden, & Gilk, 2007; Mileti & Darlington, 1997; Sandman & Lanard, 2003; Shklovski, Palen, & Sutton, 2008; United Nations, 2013; World Bank, 2012). Hence organizations involved in risk reduction often rely heavily on risk communication interventions. However, studies on health and climate change show that people will not automatically act in the way risk managers want or expect, even when provided with such information (van der Linden, 2014 cited in IFRC, 2014; Marteau & Kinmouth , 2002). Other critiques argue that humans are fundamentally viewed as:

> hedonic calculators calmly seeking to pursue private interests. We are said to be risk-aversive, but alas, so inefficient in handling information that we are unintentional risk takers; basically we are fools. (Douglas, 2013, p. 13)

The assumed linear causative relationship between 'objective' risk, risk perceptions and risk-reducing behaviours is a reductive caricature of human behaviour that is based on methodological individualism. Accordingly, social actions are the result of individual judgment and choice, which shifts responsibility and blame to the individual. Thus, these approaches do not take into account how the social, cultural and economic factors, in any given social context, may shape the way an individual understands and responds to risk (Douglas, 2013; Lupton & Tulloch, 2002).

Despite these limitations, the rational actor model – characterized by its linear, problem-solving process and positivist epistemology – still informs risk-reduction policy despite strong criticism of its straightforward and commonsensical depiction of human behaviour.

### 2.2. *Socially constructed risk*

Alternatively, there are social constructivist interpretations of risk perceptions and human behaviour. These approaches explain why public risk perceptions and behaviours are often at odds with scientific estimates of risk and the expectations of organizations involved in risk reduction. They also identify how and why risk perceptions and responses to risk vary considerably among populations and over time.

Etymologically, social constructivism asserts that risk is not an objective and naturally determined entity, but is socially produced. However, since all estimates 'involve a range of judgements determining the parameters of the issue', the ontological distinction between 'objective' and 'perceived' risk is inaccurate because the measurement of risk inevitably encompasses human interpretation (Pidgeon, Hood, & Jones, 1992, p. 90). Despite this, the present paper acknowledges the usefulness of standardized models that can be used to measure risk across space and time. This distinction also provides an opportunity to question how and why 'perceived' and 'objective' risk may not reflect one another, which will help explain how and why people prepare in different ways to the impacts of climatic hazards.

A risk perception is understood as a socially constructed phenomenon that is not governed by the cognitive ability of a person to understand the properties of 'real' risk (Douglas, 2013; Jasanoff, 1998). It may be constructed by a wide variety of social, economic, political and cultural factors. These include scientific or technical definitions; personal experiences; social norms; emotion; imagery; trust; values and worldviews (Leiserowitz, 2006; Weber, 2010). Therefore, social learning circumscribes what is understood as dangerous and how much risk a person will tolerate (Dake, 1992; Hardin & Higgins, 1996; Rippl, 2002; Rohrmann, 1994). Therefore, risk perceptions are tightly bound up with the characteristics of a person, such as gender, age, sexual identity, national identity or disability because these characteristics affect how an individual experiences the social world and their role within it (Douglas, 2013; Hopkins, 2013). What might be perceived to be 'risky' in one era at a certain locale may no longer be viewed so in a later era, or in a different place (Douglas, 2013, p. 1).

Unlike realist and rational actor theories, people are not labelled 'irrational' or unable to comprehend 'real' risk when perceptions do not match or where risk reduction is not prioritized. Cultural, social, economic or political factors influence human behaviour and help explain why people do not always engage in risk-reducing behaviour, even when they have high-risk perceptions (Douglas 2013). Burton, Kates, and White (1993, p. 65) argue that people often have alternative objectives and so do not always prioritize risk reduction;

> In many instances they [vulnerable people] would have goals quite different than maximizing the expected utility. The bounds on rational choice is dealing with natural hazards, as with all human decisions, are numerous.

'At-risk' individuals often view other immediate and everyday problems, such as income security or education, getting water, crime and road accidents as more important and pressing matters than the impacts of hazards (Barberi et al., 2008; DFID, 2005; IFRC, 2014; Shepherd et al., 2013). This relates to the 'risk hierarchy', whereby people generally give:

> A very low priority to the serious hazards that disaster risk reduction agencies try to deal with. They apply much higher significance to problems of everyday life and issues that they have to confront for normal survival, most of which are linked to their livelihoods. (IFRC, 2014, p. 67)

Others highlight the influence of trust and argue that people are discouraged from risk-reduction strategies when they trust external actors such as local authorities to reduce risk on their behalf (Baan & Klijn, 2004; Hung, Shaw, & Kobayashi, 2007). Further, some studies argue that even when people want to reduce risk they may lack the resources, such as time, skills and economic capital to reduce risk, which is strongly related to their vulnerability levels (Grothmann & Reusswig, 2006).

In sum the influence of risk perceptions on responses remains unclear and there are several contradictions within the large body of research that attempts to map their relationship. In light of this, the rest of this paper applies a social constructivist lens to explore the formation of risk perceptions and how and to what extent they shape social experiences of risk. In order to do this, processes located beyond the properties of 'real' risk are considered, as to do otherwise is to reduce human behaviour to nothing more than a caricature. The next section introduces the case study and discusses findings in light of current knowledge.

## 3. Discussion

Results are based on nine months of ethnographic research that took place in 2012/2013, as well as two short two week return visits in 2014 and 2015. Data were collected in three adjacent urban neighbourhoods of Cochabamba city, Bolivia. These neighbourhoods are located in 'Cerro Lourdes', a hill located 4 km from the city centre. The Cerro has become densely populated since in migration began in the 1950s, and in 1999 the municipality of Cochabamba expanded the urban area of the city to include the Cerro (Landaeta 2004). This brought the legal and political recognition of the neighbourhoods and since then there have been significant improvements, particularly in relation to infrastructure, access to basic services and transport links. It is important to note here that 96% of the population self-identify with a denomination of Christianity; however, religion has a limited role in shaping how people understand risk.

Analysis is based on 72 key informant interviews on the local level with government representatives, architects, informal construction workers and neighbourhood-level leaders, as well as extensive interviews with neighbourhood residents. Residents also produced participatory drawings of their house. They act as social maps that

uncover the ways that people perceive and interact with the materials and space within the house (Kumar, 2002). A quantitative survey was also distributed to 390 households (33% of households).

### 3.1. *'Objective' risk*

The population of Cerro Lourdes experiences everyday climatic hazards that are linked to slow-onset and small-scale disasters. Desinventar (n.d.) define small-scale as between one and one hundred households that are affected at any one time. However, within the Cerro it is rare that a large number of households experience the most serious impacts at any one time.[5] It is more common that one or two households simultaneously experience serious impacts such as landslips. The cumulative impacts of climatic hazards amount to large-scale economic loss and damage within the area, which illustrates the importance of further research on small-scale disasters (Bull-Kamanga et al., 2003).

Impacts play out in two different ways. Survey data show that 53% of houses have been damaged by rainfall, which dampens and cracks the walls of adobe[6] houses, and which can lead to the partial or total collapse of the house. Second, rainfall exacerbates ground instability, which has led to 29% of houses experiencing landslips. Additionally, over time 'light' damage such as cracks in walls can graduate into more serious damage because of the persistent impacts of rainwater (Bull-Kamanga et al., 2003). However, physical damage is not only determined by rainfall patterns, but also exposure to rainwater and the materials used to build the house.

Levels of risk are asymmetric within and across households. Vulnerability, which is here defined as 'the capacity to anticipate, cope with, resist and recover from the impact of a hazard' (Blaikie, Cannon, Davis, & Wisner, 1994, p. 11), is also disproportionate within and across households due to heterogeneous levels of access to, and quality of physical, human, social, economic and political capital assets (Moser and Stein 2011). Exposure to rainwater is also uneven because of topography, the density of the neighbourhoods, a lack of surface drains in many parts of the neighbourhoods and because many houses do not have gutters, and so rainwater is redirected to adjacent houses (Wamsler, 2014). Within households, women are often the most exposed and vulnerable as they spend most of their time within the house, taking care of domestic duties and so are often unable to engage in paid labour (Bradshaw & Fordham, 2014; Cannon, 2002). This is also true of the elderly who do not work and who are also on the 'front line' when hazards impact on the house (Ajibade, McBean, & Bezner-Kerr, 2013).

Although the majority of the population experience the adverse impacts of climatic hazards, there is weak public institutional capacity to address these impacts. This is indicative of the urban 'vulnerability gap', pointing out a 'lack of knowledge and financial capacity (and sometimes willingness) of urban authorities to reduce risks', particularly in medium-sized 'southern' cities such as Cochabamba (IFRC, 2010, p. 20). Therefore, the population receives negligible external coordinated support before and after hazard impacts. Consequently, preparedness, response and recovery activities largely take place at the household level (UNISDR, 2012; Wamsler, 2014).

### 3.2. *Constructing risk: asymmetrically, temporally and internally*

In line with a social constructivist position, what constitutes a threat for people is largely to do with individual perceptions than attributes of 'objective' risk. Instead, risk perceptions are asymmetric within and across households because of the diverse ways that people experience and interpret signals about their risk from climatic hazards (Jasanoff, 1998). Despite this, there are several elements that are universal – namely the temporality of perceptions, and the extent to which people perceive risk can be controlled.

Reflecting earlier research, experience with the adverse impacts of hazards is one of the most significant factors influencing how probable and negative an individual perceives impacts will be (see Grothmann & Reusswig, 2006; Ruin, Gaillard, & Lutoff, 2007; Wachinger et al., 2013). People with direct and indirect experience perceive they are at risk.[7] However, those with direct experience perceive that damage is more probable and will occur in the more immediate future than people with indirect experience (Ruin et al., 2007). This is because direct experience provides vivid and rapid recall of information, greater personal involvement and lower levels of uncertainty (Weinstein & Nicolich, 1993). In addition, people who have experienced severe impacts expect future impacts to be more life threatening, and typically display greater levels of anxiety (Felgentreff, 2003; Finucane, Alhakami, Slovic, & Johnson, 2000; Ruin et al., 2007). However, concern with risk is most acute in the period after initial impact, but gradually diminishes over time (Weinstein & Nicolich, 1993).

After a landslide affected 72 households in 2008, the local government created a colour-coded risk map to validate and encourage the resettlement of the affected population. High-risk zones are identifiable by the colour red, medium risk with orange, low-risk zones are represented as yellow, and supposed no-risk zones are depicted as green.[8] Findings support a small body of work that shows that the visual rhetoric of maps has significant sway on risk perceptions (Crozier & Glade, 2006). The influence of this risk map is buttressed by its presentation as objective and scientifically rigorous, which marginalizes people from questioning the results it is based on (Felli & Castree, 2012; Hajer & Versteeg, 2005). People living in

supposed high- and medium-risk zones display more concern with potential landslides and perceive damage will occur sooner and will be more negative, whereas those located in low- and no-risk zones tend to de-emphasize the likelihood of a landslide and potential damage.

The map has significant discursive power – at a stroke, it condenses the complexity of risk. Landslides are represented as natural events that are beyond human control, and 'escape' from the area is implied as the only solution. Yet, despite the local government's efforts to naturalize risk, the map fails to convince people that their only option is to relocate to 'less risky' land. In fact, people identify that the locus of control of disaster risk is internal to human action. In other words, people understand that they have personal control of risk and can take actions to reduce the impacts of rainfall. This is significant because the more control a person perceives they have, the more likely they are to take actions to address their risk (Schmidt, 2004). This finding sits in contrast to previous research which suggests people perceive they have little to no control over the impacts of natural hazards because they ascribe the cause of a disaster to the particular characteristics of the hazard or divine determinism (see Gaillard & Texier, 2010; Schipper, 2010, 2015). The reason for this divergence from previous literature can be explained by looking at the scale and speed of onset of impacts.

The current research focuses on small-scale impacts that have a slow speed of onset. For example, it can take from 3 months to 20 years for the wall of a house to collapse entirely. This is not insignificant as it shapes risk perceptions in distinctive ways that diverge from previous research, which has tended to focus on large-scale and rapid-onset disasters (e.g. Gierlach et al., 2010; Heitz et al., 2009; Jóhannesdóttir & Gísladóttir, 2010; Motoyoshi, 2006; Takao et al., 2004). Firstly, it allows people to monitor the incremental impacts of rainfall, which provides a visual indicator that small effects from rainfall accumulate over time and can be tipped into more serious impacts. Ultimately, this facilitates people to understand that risk is symptomatic of the interaction between their exposure and (physical) vulnerability – namely the design and materials of their house. Therefore, the design and materials of people's houses significantly shape risk perceptions. Specifically, adobe is associated with higher levels of vulnerability, whereas brick and concrete are strongly linked to high levels of resilience. Critically, most of the population live in self-built houses, whereby they decide where, how and when they want to build, but do not necessarily construct the entire building. Across the Cerro there has been a widespread shift towards brick and concrete and this is reflected in self-build housing patterns across Latin America (Forty, 2005) and urban Bolivia (INE, 2012). The survey reveals that 11% of houses are entirely constructed with adobe, 58% are a mixture of adobe and brick/concrete, and 31% are made only of brick and concrete.[9] Additionally, a deep foundation and a retaining wall are also associated with lower levels of physical vulnerability and are present in 50% and 43% of houses, respectively. As such, the diverse design and materials of houses contribute to the asymmetrical perceptions of risk across the population.

Finally, there has been a tendency to suggest that people find it difficult to understand that risk can intensify over time because their risk perceptions are bound by present and past experiences (Grothmann & Reusswig, 2006; Ruin et al., 2007; Wachinger et al., 2013). In contrast, the population of Cerro Lourdes recognize that their future levels of risk are connected to the ongoing, subtle and often visually observable impacts of rainfall, which supports Siegele (2012). They do not perceive that distant and future impacts are generally abstracted from their everyday lives. Rather, they acknowledge that their risk can increase incrementally with the persistence of rainfall, and that there is a 'delay effect' between initial impacts of hazard and more serious damage. This time-dependent characteristic affords people a warning period where they can prepare to reduce the severity of impacts; this is explored in more detail in the next section (Blaikie et al., 1994) . Therefore, residents' perceptions of slow-onset risk are broadly in line with the long-term temporal scale that is often used for understanding and adapting to the impacts of climate change (e.g. Gero, Meheux, & Dominey-Howes, 2011; Mercer, 2010). Although the projections by disaster managers and the population may not be homogenous or shaped by the same factors, agenda, experiences or knowledge, this finding challenges the pervasive assumption that long-term predictions about risk are isolated to the skill set of risk professionals who use technical, professional and sophisticated prediction models**.**

Crucially, the long-term temporal structuring of risk perceptions and the perception of personal control over risk is not disengaged from people's present behaviour. People make substantial investments of their resources in ways that reduce their current and future risk. However, as the next section shows, DRR is not the most important reason why people engage in these activities.

### 3.3. *Mainstreaming preparedness*

Data from the survey, semi-structured interviews as well as participant observation show that people engage in several activities to reduce the physical impacts of climatic hazards. These include sweeping away rainwater and placing plastic sheets around the base of the house to avoid exacerbating ground instability. However, data from interviews as well as the participatory drawings of houses show that people perceive the physical form of the house as the most important resource for reducing the impacts of climatic hazards.[10] Subsequently, (re)construction of the house is widely perceived as the most effective

form of disaster preparedness. Illustrating this, 97% of survey respondents felt safer against the impacts of climatic hazards after constructing brick and/or concrete rooms, a retaining wall or a deep foundation, which were highlighted above.

However, there is no significant distinction in the design and construction of self-build housing between individuals with high- and low-risk perceptions. People who believe that the impacts of climatic hazards are more likely and will be more severe equally build or plan to build their houses with brick and concrete, a deep foundation and a contention wall, as people who perceive impacts are less probable and will be less serious. This is because the nature of a person's risk perception has less influence on human behaviours than previous research often suggests. Rather, this research finds that brick and concrete, a contention wall and a deep foundation are associated with 'good practice' because of their association with DRR. They therefore represent local 'architectural norms' that are automatically incorporated into the physical form of the house when people decide to build and have the resources to do so. Therefore, it is not the risk perception which shapes disaster preparedness, but rather because risk-reducing construction features represent standard and integral features of the local architecture across the Cerro.

Although local building codes stipulate that a contention wall and deep foundation must be built, this does not adequately explain why the local population increasingly adopts these features. This is first because the survey confirms that 63% of residents are unaware of the existence of building codes, and second, even where residents are aware of the codes, many have never seen the codes and have limited knowledge of what they entail. Further to this, interviews with the local population as well as local government official reveal that the local government invests minimally into the inspection of houses. Informants in the local government indicated that only three households had received a fine since building codes were introduced in 2004. Therefore, it would be overly simplistic to suggest that the local government's 'stick', so to speak, has catalysed the integration of disaster preparedness. Rather, this study shows that disaster preparedness activities are mainstreamed into self-build houses. The process of mainstreaming has principally been employed to discuss DRR and climate change adaptation policy (see Huq, Rahman, Konate, Sokona, & Reid, 2003). In this context it refers to the need for government and donors to consider risks emanating from natural hazards and to treat risk reduction as an integral part in legislation and institutional structures, in sectoral strategies and policies, in budgetary processes and in the design and implementation of individual projects. As such, it ensures that DRR is incorporated into other development priorities rather than being viewed as an end in itself.

To demonstrate that the population is mainstreaming disaster preparedness, it is necessary to highlight the different objectives that catalyse and influence how people design and construct their house. These relate to personal taste, public social status, economic security, privacy, health, comfort and efficient domesticity.[11] Some of these priorities are not considered traditional development goals (United Nations, n.d.) however, what is important is that the population consider them significant to their lives and livelihoods and that these motivate housing (re)construction, which ultimately results in the integration of disaster preparedness. The following discussion draws on research on self-build housing in cities of the global south. As previously stated, this research applies an anthropocentric conceptualization of the house, whereby the house is not only a physical resource, but also a resource to transform social, economic and cultural processes that may or may not be directly related to risk reduction (Blunt & Dowling, 2006; Kellett, 2005; Klaufus, 2012; Rapoport, 2003)

Findings support Klaufus (2012), as the design and materials of a house is a way of communicating how household members want to be seen and to avoid negative assessments and judgments. Interviewees emphatically explained that they had (re)constructed, or aspire to reconstruct the house in order to achieve the style that their 'dream house'. There were different interpretations about how this could be achieved, and which displayed the individuality and personal tastes of people. However, reflecting research by Inclan Valadez (2013)) , a desire to give their house a status of beauty, sophistication and style draws them together, and the choice of construction materials is key to this process. The transition from adobe to brick and concrete allows people to build larger houses, which may be three or four storeys in height and which often have elaborately decorated facades. Single-storey adobe houses, originally dominated the Cerro, and so this new architecture represents a form of 'conspicuous consumption', according to Klaufus (2012). In other words, it visually expresses the socio-economic status of the household and is a way of claiming higher public social status, particularly because brick is associated with higher levels of economic income. The importance of public social status is also apparent when entering houses as it is often only then that one can observe the material poverty, which is hidden from public view.

Larger houses also allow people to construct shops, workspaces, bars (locally known as a 'chicherias') and extra rooms that can be rented out to tenants. This provides a source of income that transforms the house into a productive asset, which supports the economic security of the household. This is a strategy that was employed by 43% of households who had (re)constructed their house from adobe to brick and concrete. (Re)constructing the house to support economic productivity was particularly emphasized by women who are unable to engage in paid labour outside of the house, because of a gendered

domestic division of labour. Survey data show that across the Cerro 67% of new home-based enterprises are run by women, and many women commented that having a personal economic income has increased their household bargaining power, which supports other research on gender and household bargaining power in cities of the global south (e.g. Moser, 2010).

A larger house also fundamentally changes the layout, which affects the privacy and comfort of household members in ways that are desirable among the population. Single-storey adobe houses have limited space and so it is common for as many as nine household members to share a single dwelling unit for multiple activities such as sleeping, socializing, eating and cooking. Therefore, more rooms ensure less people share a single dwelling unit. Survey and interview data reveal that this is particularly important in the Cerro where multiple generations of the same family reside in the same house because they do not want, or lack the resources, to move out of the family home. Reflecting Kellett's (2005) work on self-build housing in the global south, a private dwelling unit does not just signify a place to sleep, but also the ability of individuals to physically demarcate their lives as independent from other household members. Building on the importance of privacy, residents of the Cerro also emphasized that they wanted a larger house in order to incorporate the kitchen and bathroom inside of the unitary structure of the house. This is highly distinct to adobe houses with their external patios where people prepare and cook food and where a freestanding bathroom is typically located.

Interviewees, and women in particular, also referenced the importance of maintaining the order and cleanliness of the house, which can be difficult with adobe houses with their confined spaces, large numbers of household members and a lack of storage space. Further, earth floors, which are typical of adobe houses, can create a dusty environment, whereas brick walls and concrete floors are easier to clean and maintain the tidiness of the house. Kellett (2005) finds that careful consideration of order and tidiness is particularly important in cities of the Global south as it helps signify that inhabitants are decent people who live in a 'good home' and this was reflected in data from interviews and participatory drawings. As highlighted above, because of heavily gendered domestic duties, women are far more concerned with the time and labour-saving elements of brick and concrete because it allows them to become more efficient domestic workers and allows them to spend time on other activities, which has been found in global north and south contexts (see Blunt & Dowling, 2006).

Benefits to health are another central reason why people are transitioning to brick and concrete houses. Insects known as vinchucas often live in un-rendered adobe walls – they transmit the protozoal parasite through their bite, which can lead to the fatal disease Chagas (Boven & Morohashi, 2002). Survey data show that the reduction of risk of contracting Chagas was a principal reason for building with brick and concrete in 72% of households. Many development organizations working in Bolivia have implemented programmes with the principal purpose of making houses vinchuca proof (e.g. UNESCO, Building and Social Housing Foundation Bolivia).[12] Another health benefit which people emphasize is the reduction of internal temperatures and humidity. Brick and concrete are better able to buffer against the heat and humidity, whereas adobe absorb and retains the heat and moisture from the day, which can make internal living conditions particularly uncomfortable during the rainy season from December to March.

The reasons that motivate people to (re)construct their houses are diverse. Some of them such as health reflect traditional development goals. However, others such as public social status, the desire for a beautiful home, domestic efficiency, cleanliness and privacy are not considered traditional development objectives. Nevertheless, these goals are encouraging many people to fundamentally change the design and construction of their houses, and through this process, disaster preparedness is automatically being incorporated.

## 4. Conclusions

This paper has shown that realist position and rational actor theories are insufficient for understanding risk perceptions and social experiences of risk. People's perceptions of risk do not mirror 'objective' risk – they are asymmetrical within and across households because people do not experience the world or interpret signals about risk in the same ways. Additionally, a focus on everyday climatic hazards that are linked to slow-onset and small-scale impacts allowed the paper to show that people perceive risk in sophisticated ways. Perceptions have a long-term temporality, as people understand that risk can increase incrementally over time and that their future levels of risk are not abstracted from their present behaviours. Additionally, and despite 96% of the population self-identifying with Christianity, risk is understood as a process that is internal to human action – that actions can be taken to address the impacts of climatic hazards. This is contrary to a large body of research that argues people who identify with a religious faith often understand risk as a natural/biophysical process or an act of god (see Gaillard & Texier, 2010; Schipper, 2010, 2015) As such, the paper directly challenges the pervasive assumption that people lack the ability to comprehend disaster risk (IFRC, 2014; Jóhannesdóttir & Gísladóttir, 2010; Lewis et al., 2011). Furthermore, the paper suggests that complex understandings about risk are not isolated to the skill set of disaster managers that use technical, specialized and sophisticated models of analyses.

This understanding of risk informs people's responses to risk as people take control of their risk in order to address their current and future levels of risk. People view the house as the most important resource for reducing disaster risk. Within the field of disaster studies, the house is often conceptualized as a physical resource to reduce physical vulnerability and to access and consolidate social, economic, human and political capital that may also reduce risk (e.g. Bosher, 2008; Lorch, 2005; Wamsler, 2014). Therefore, it is explicitly or implicitly suggested that the ways which people design and construct their houses is wholly, or largely, influenced by people's desire to reduce the impacts of hazards. However, this paper has drawn on literature on self-build houses in 'southern cities' to show that the house is more than a physical resource to provide shelter and safety from harm. Rather, it allows people to transform and facilitate a diversity of social, economic and cultural processes, which may not be directly related to risk reduction (Blunt & Dowling, 2006; Kellett, 2005; Klaufus, 2012; Rapoport, 2003). And in this particular case, personal taste, public social status, economic security, privacy, health, comfort and efficient domesticity largely catalyse and determine the way that people design and construct their house.

Through this approach the paper shows that the particular nature of an individual's risk perception is less influential than previous research argues. People with high and low-risk perceptions equally build, plan to build or aspire to build their house so as to reduce their present and future risk because brick and concrete, a deep foundation and a contention wall, which are associated with risk reduction, are local 'architectural norms' that are desirable and viewed as 'good practice'. As such, they are automatically incorporated, or 'mainstreamed' into the design and construction features of the house when people decide to build and have the resources to build (Wamsler, 2014).

The article therefore suggests that any attempts to trace the influence of risk perceptions on human responses must remain critical of adopting terms such as rational and irrational which support marginalizing debates about people's ability to understand risk. There is also the need for researchers to look beyond disaster risk vernacular and analyses if they are to identify and understand the underlying mechanisms that shape human behaviour. In light of these findings and the cumulative economic and physical losses of small-scale impacts, it would be beneficial for further research on alternative types of risk, rather than a continued focus on infrequent, rapid-onset hazards that are linked to large-scale disasters.

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## Notes

1. This article focuses on disaster-risk reduction (DRR), rather than climate change adaptation (CCA). However, it is impossible to separate DRR from CCA. Global warming is driving increased frequency and/or severity of climate-related hazards. These hazards damage the livelihoods of people, in turn making them increasingly vulnerable, and subsequently increasing their disaster risk (IFRC, 2014; IPCC, 2014).
2. Everyday refers to hazards which are constantly present or common in the urban environment (Bull-Kamanga et al., 2003).
3. Assets are the 'stock of financial, human, natural or social resources that can be acquired, developed, improved and transferred across generations.' (Ford, 2004).
4. The ontological position of objective risk is inaccurate as measurement inescapably encompasses human interpretation when making judgements about the parameters to measure risk (Pidgeon et al., 1992, p. 90).
5. In 2008 there was a landslide that affected 72 households at one time.
6. Sun dried bricks made of mud, water and straw.
7. Indirect experience indicates damage to property or person, and witnessing the immediate impacts of a hazard with one's own eyes. Indirect experience is found in secondary sources of information provided through informal social networks, opinion leaders, the media, personal networks or public agencies.
8. Despite the rhetoric from the local government, the map only indicates levels of ground instability, while exposure to rainwater and measurements of vulnerability are overlooked in the analysis of risk.
9. Census data shows that 81% of houses were entirely made of adobe in 1992 and that this number dropped to 73% in 2001 (INE 2001).
10. Other research has shown that the house is often used as a resource to reduce disaster risk in cities of the global south (Green 2008; Wamsler, 2014).
11. These factors are not exhaustive, however they are the aspects that interviewees emphasized. For further reading on the factors that motivate and shape housing (re)construction in cities of the global south see Inclan Valadez, 2013, Kellett, 2005, Klaufus, 2012, Turner, 1976.
12. Physical improvements are part of an integrated programme, which also includes education on the causes of Chagas disease and training in vigilance methods.

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