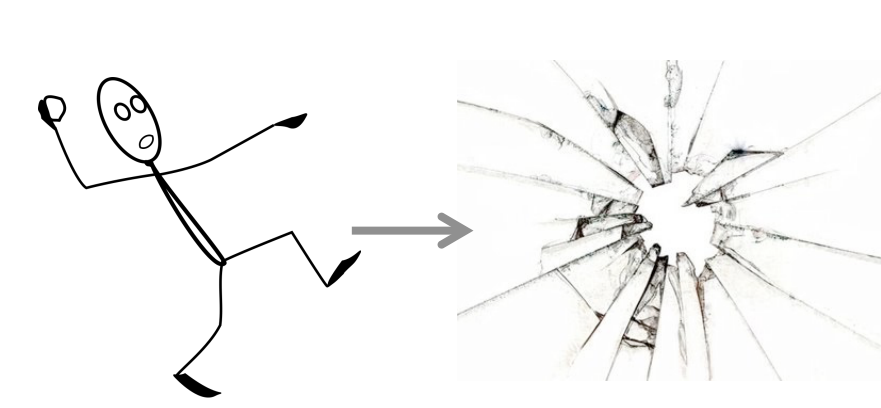
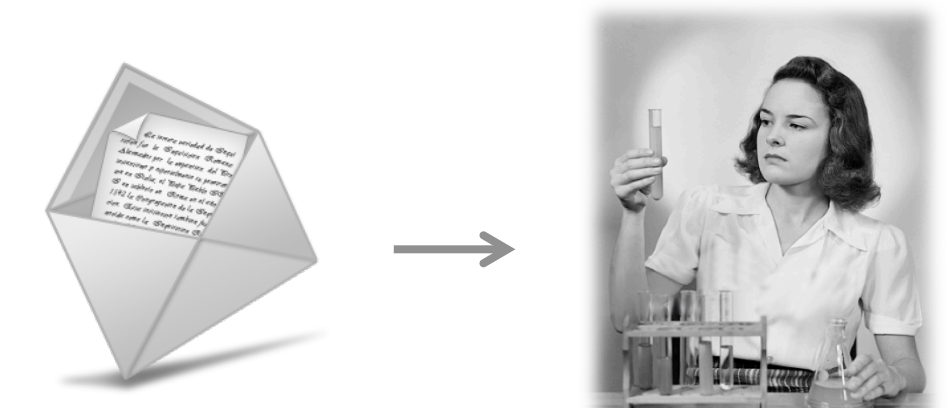


Controlling for average causal strength and number of intermediate links, does **stability** influence the evaluation of causal claims?



Throwing a rock at a window  
→ window breaks

Stable causal relationship  
(also strong & direct)



Writing a reference letter for student  
→ student's later scientific discovery

Unstable causal relationship  
(also weak & with a longer causal chain)

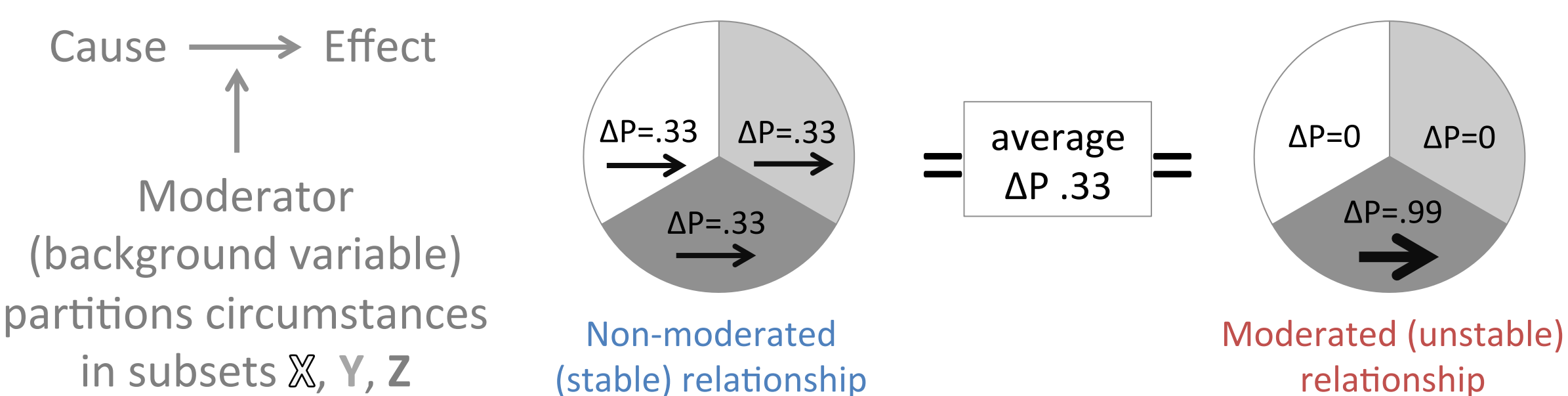
**Stability (insensitivity) of a causal relationship** - the extent to which a causal relationship  $X \rightarrow Y$  holds in a variety of background circumstances

**Background circumstances:** "circumstances that are not explicitly represented in the X-Y relationship, including both circumstances that are causally relevant to Y and those that are not." (Woodward, 2010, p. 290)

Woodward: "Causal relationships should exhibit some degree of generalizability or exportability or context independence." (2006, p. 7)

Stability: not captured by existing measures of causal strength, which track *average* strength of a causal relationship in a population, e.g.  $\Delta P (P(E|C) - P(E|\sim C))$  or power-PC ( $\Delta P / 1 - P(E|\sim C)$ )

Allan, 1980; Cheng, 1997; Cheng & Novick, 1990; Jenkins & Ward, 1965

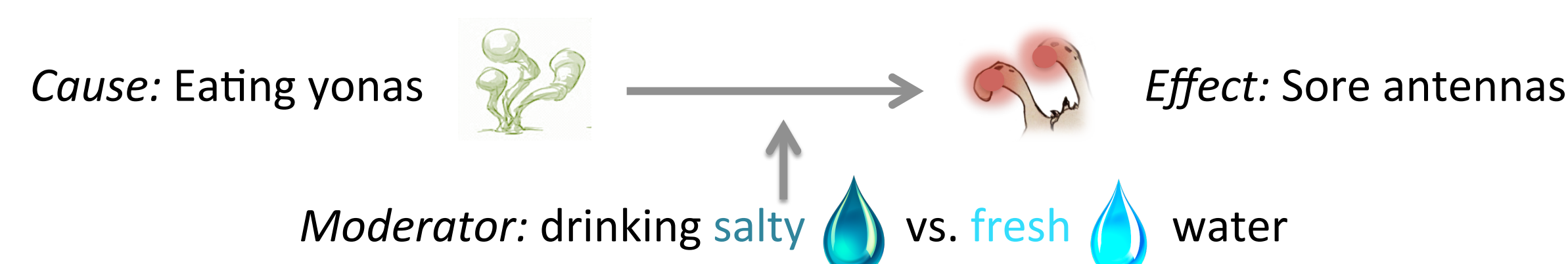


## Prior empirical work

- Indirect evidence:** Causal judgments in double-prevention scenarios track stability of relationships (Lombrozo, 2010); Agents are seen as less causal if controlled by third parties (causal relation sensitive to 3rd party intentions) (Murray & Lombrozo, 2016; Phillips & Shaw, 2015)
- Mixed evidence:** robustness of an outcome (whether a ball clearly or barely went through a gate) does not affect "cause" vs. "prevent" judgments, but predicts choices among descriptors of causal relationships ("[almost] caused/prevented", etc.) and has some effect on judgments of responsibility assigned to potentially competing causes in complex causal structures, including causal chains (Gerstenberg et al., 2012, 2015).

## Experiment 1: Are stable causal relationships better causal relationships?

**Objective:** to vary stability while holding causal strength fixed; measure endorsement of causal & explanatory claims (not qualified by reference to background conditions)



"You are a scientist on planet Zorg. You study a lizard-like species called the zelmo..."

**Non-Moderated (stable) relationship**

Drank salty water: (200 zelmos)		Drank fresh water: (200 zelmos)		
Eaten yonas in the past week?	Yes	No	Yes	No
Yes	67 zelmos	32 zelmos	71 zelmos	33 zelmos
No	33 zelmos	68 zelmos	29 zelmos	67 zelmos

$\Delta P_{SALTY} \sim .40$        $\Delta P_{FRESH} \sim .40$

**Moderated (unstable) relationship**

Drank salty water: (200 zelmos)		Drank fresh water: (200 zelmos)		
Eaten yonas in the past week?	Yes	No	Yes	No
Yes	93 zelmos	7 zelmos	51 zelmos	52 zelmos
No	8 zelmos	68 zelmos	48 zelmos	49 zelmos

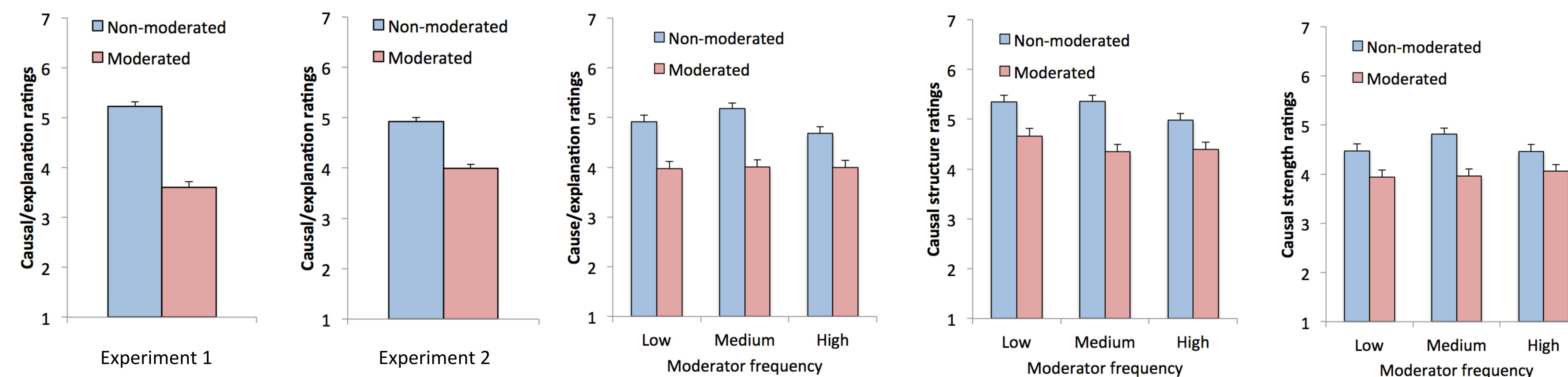
$\Delta P_{SALTY} \sim .80$        $\Delta P_{FRESH} \sim .00$

Dependent variables

	Causal judgment (C causes E)	Explanation judgment (E because of C)
<b>Type</b>	How much do you agree with the following statement about what causes zelmo's antennas to become sore? For zelmos, eating yonas causes their antennas to become sore.	How much do you agree with the following explanation of why zelmos' antennas become sore? For zelmos, antennas become sore because of eating yonas.
<b>Token</b>	Your assistants select one of the zelmos with sore antennas from your second experiment. They call him Timmy. During the experiment Timmy has eaten yonas. You do not know whether Timmy drank fresh water or salty water during the experiment. How much do you agree with the following... ... statement about what caused Timmy's sore antennas? Eating yonas caused Timmy's antennas to become sore.	... explanation of why Timmy has sore antennas? Timmy's antennas became sore because he ate yonas.

(1 strongly agree – 7 strongly disagree)

## Key finding: Across a variety of judgments, people give higher ratings to stable (non-moderated) relationships

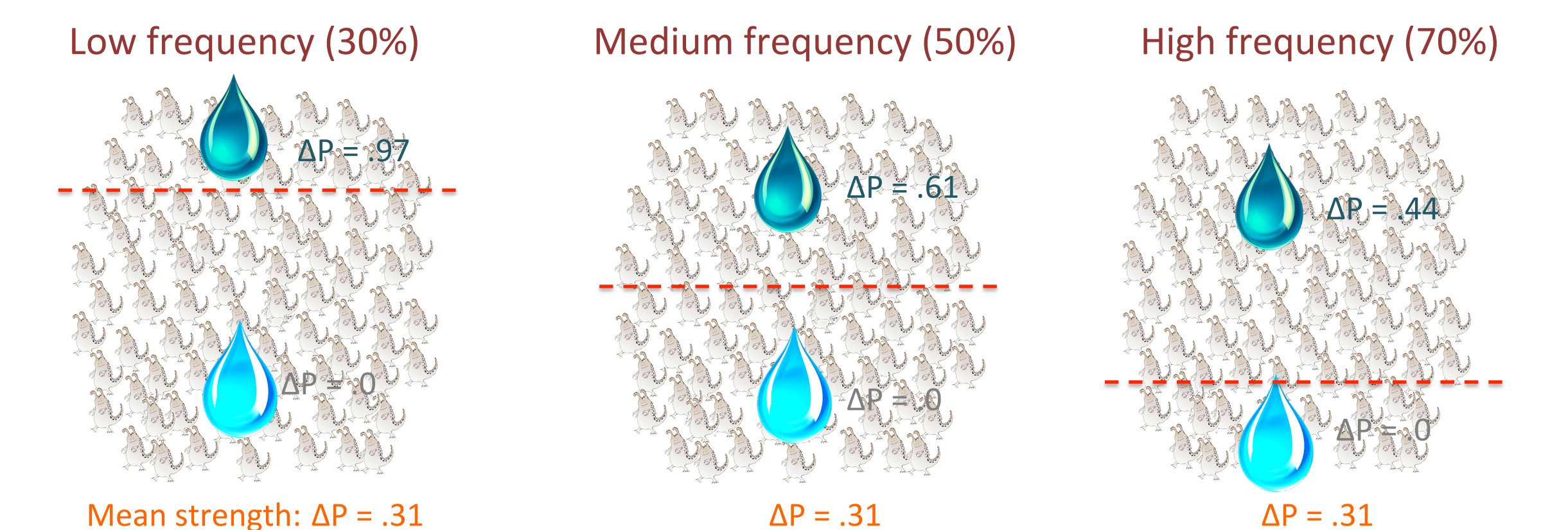


## Experiment 2: What drives the preference for non-moderated relationships: Stability? Frequency? Pragmatics?

**Objective:** to rule out alternative explanations (frequency, pragmatics) and replicate the moderator effect with additional measures

- In Experiment 1, the moderated relationship is **less stable** than the non-moderated relationship
- Is **less frequent**: holds in a smaller actual proportion of the population (50%)
- Is **potentially characterized infelicitously**: claim only applies to subset of population

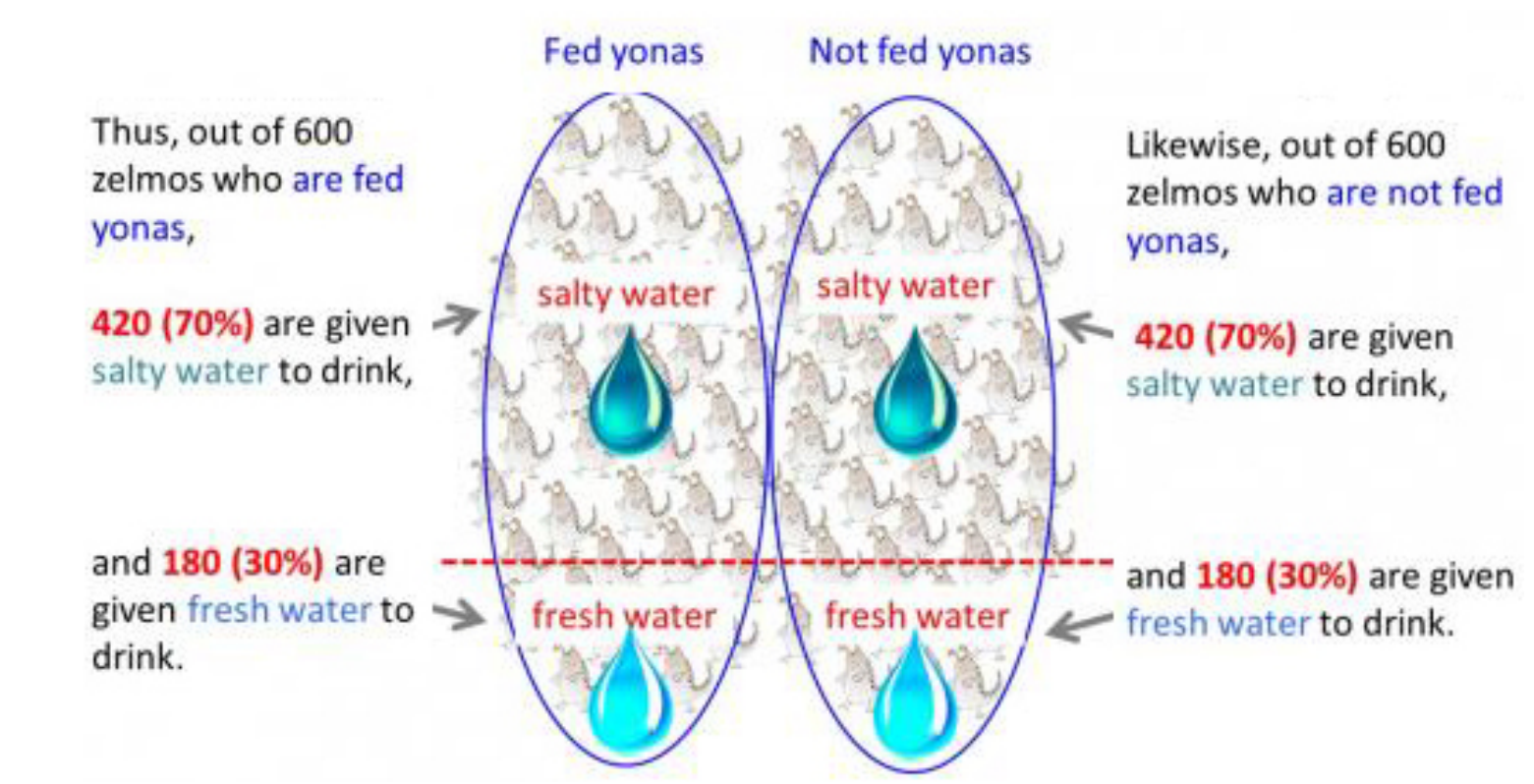
In Experiment 2, we varied **moderator frequency**: the base rate of the enabling circumstance (the moderator value for which the causal relationship held).



## Additional ratings

**Causal structure:** In your opinion, how likely is it that there is some causal relationship between eating yonas and having sore antennas? (1 not at all likely – 7 very likely)

**Causal strength:** If there is a causal relationship between eating yonas and having sore antennas, how strong do you think it is? (1 very weak relationship – 7 very strong relationship)



Sample diagram provided to participants

## Conclusions

- Stability** has a consistent effect on people's assessments of causal relationships in a wide variety of contexts (causal/explanatory judgments, type/token, structure/strength)
- Effect of stability is largely insensitive to variations in the frequency of relevant background circumstances
- These results:
  - Support Woodward's (2006, 2010) proposal about the role of stability (insensitivity) in causal judgments
  - Point to an important limitation of the dominant measures of causal importance (such as  $\Delta P$  and power-PC)
  - Provide support for the **exportability** theory of explanation and causal ascription (Lombrozo & Carey, 2006; Lombrozo, 2010)