

Plants vs. Zombies: Effects of Item Context on Student Reasoning about Natural Selection



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Students struggle to describe the process of natural selection

- Studies have shown that students have many misconceptions about natural selection^{1,2}
- While it has been suggested that context could play a role in student reasoning about natural selection³, it has yet to be fully researched

We looked for 5 common student ideas

Code	Description
Adapt⁴ [A]	Response suggests that organisms adapt (change) to be able to live in the environment.
Need⁴ [N]	Response implies that the organism needed to change to survive.
Absolute Death [AD]	Response suggests that only one phenotype will remain in the population (i.e. the fast/slow organisms with all survive/die).
Selective Agent [SA]	Response suggests that some aspect of an organism's environment is actively selecting one phenotype over another; response indicates coevolution.
Time [T]	Response states that evolution takes time or occurred over time. It can be either general or specific.

Data collected from two biology major courses

- Introductory Biology II (two sections, same semester, $n = 431$)
- Evolution (two sections, different semesters, $n = 222$)
- Pre- and post-instruction

Responses were coded by two raters

- Two independent raters coded 20% of responses, reaching $K > 0.61$ in all cases

- Disagreements were discussed and resolved
- A single rater coded the remaining responses

Code	K
A	0.61
N	0.81
AD	0.69
SA	0.79
T	0.88

We asked students to reason about natural selection for plants or animals



Sensitive plants (*Mimosa pudica*) are able to fold their leaves in about one second to escape predation. How would a biologist explain how the ability to rapidly fold leaves evolved in sensitive plants, assuming their ancestors could fold leaves in five seconds on average?

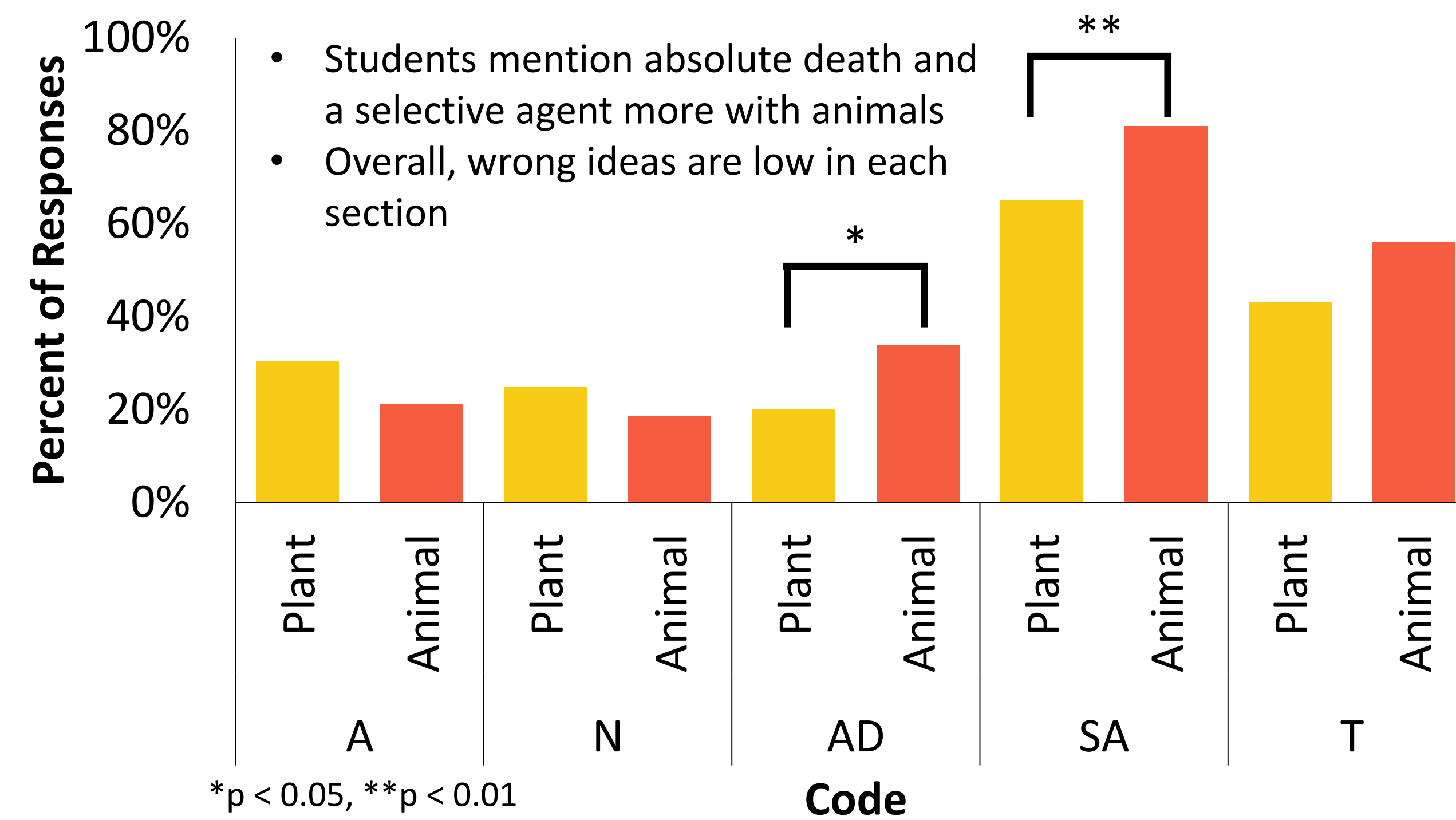
Based on the idea AD that only the strongest survive, the plants that could fold in 5 seconds were eaten while the plants that could fold slightly faster lived. The plants then adjusted over the years in order to survive. They grew & adapted.

The slowest Springboks were eaten by predators leaving the faster ones to reproduce. As the predators got faster because of their need to survive, the Springboks also continued to adapt. Over time these changes allowed the Springboks to reach 60mph.

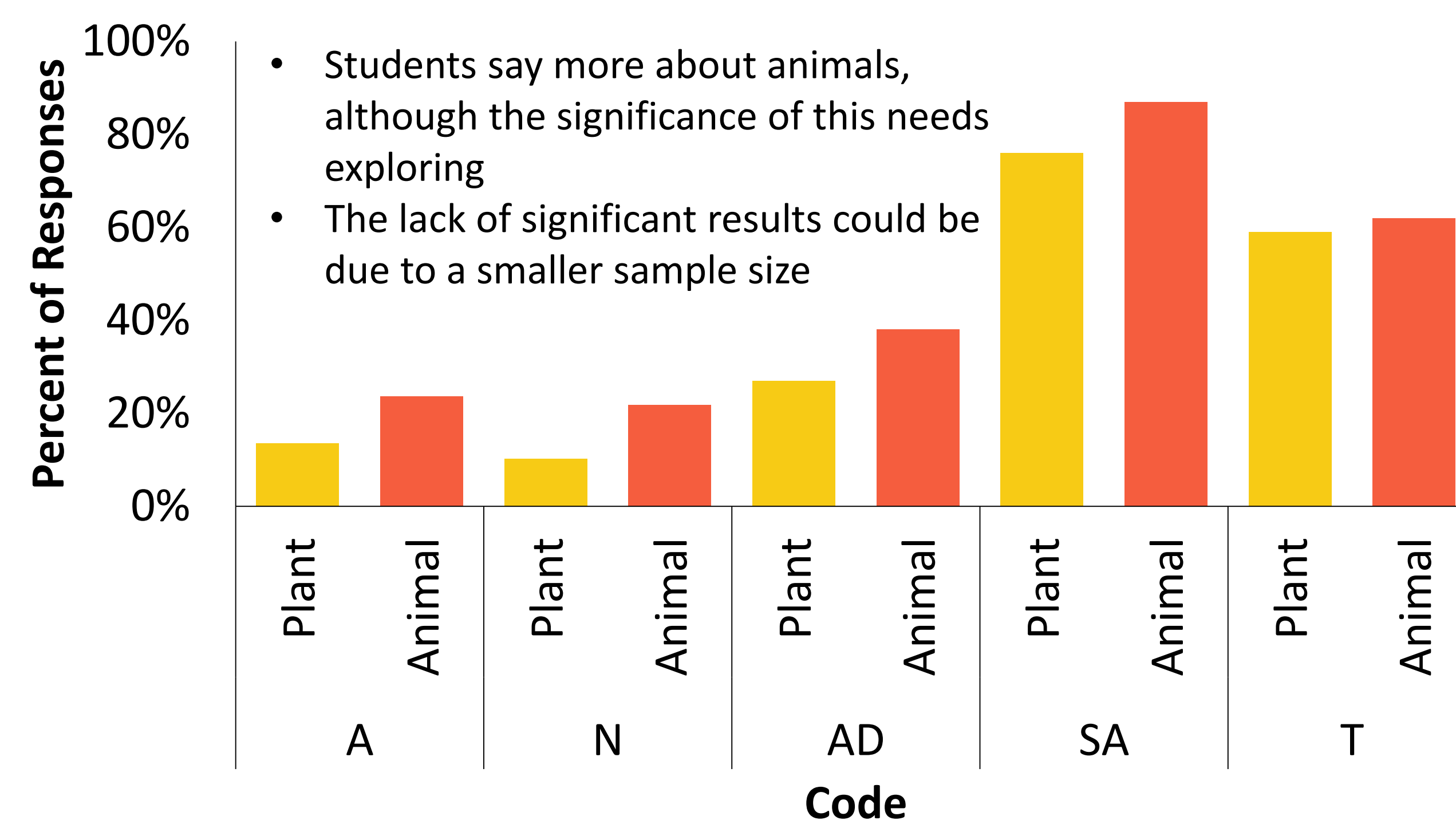
Springboks (*Antidorcas marsupialis*) are able to run about 60 miles per hour to escape predation. How would a biologist explain how the ability to run fast evolved in springboks, assuming their ancestors could run 30 miles per hour on average?



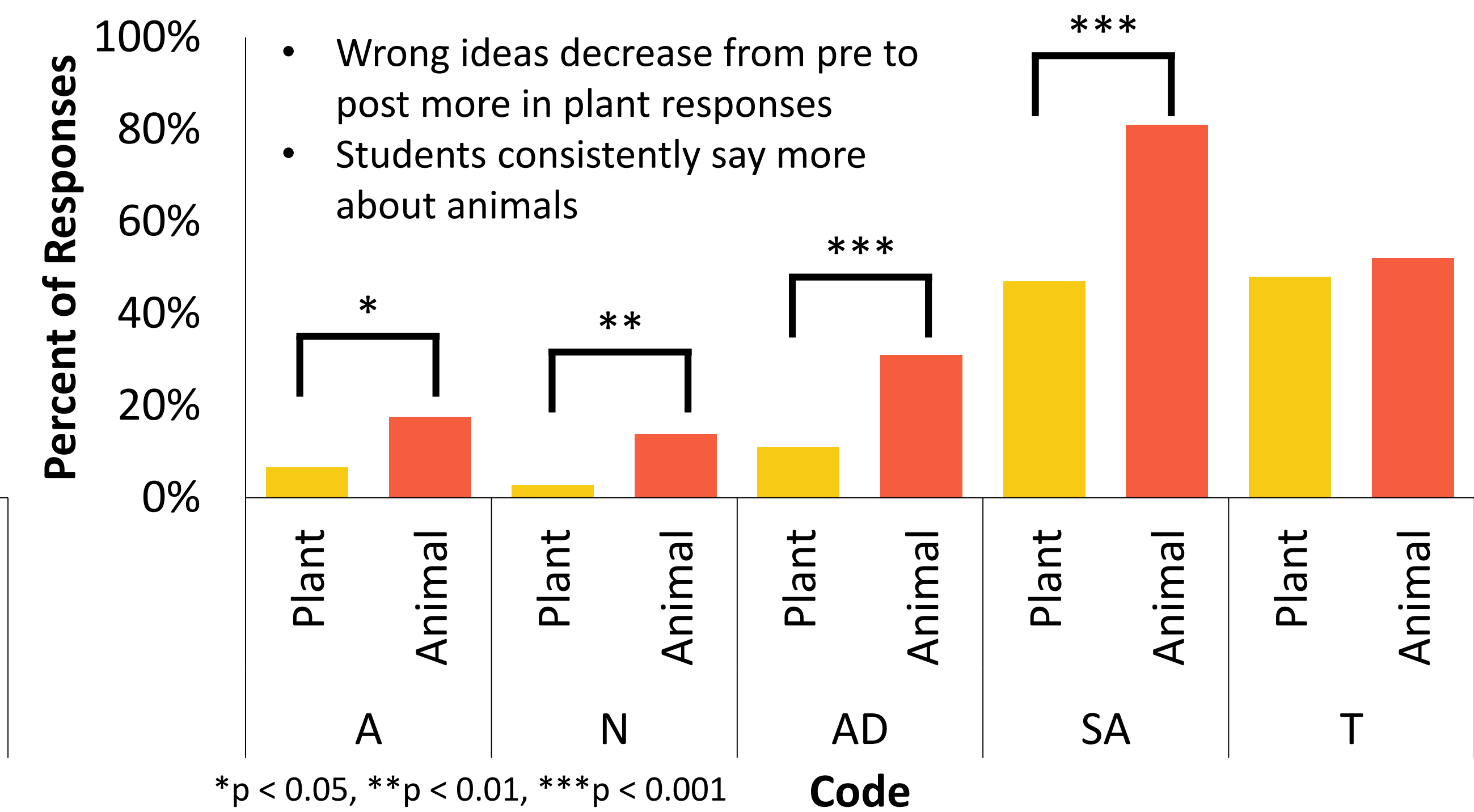
Intro Biology II: Pre-Assessment ($n = 216$)



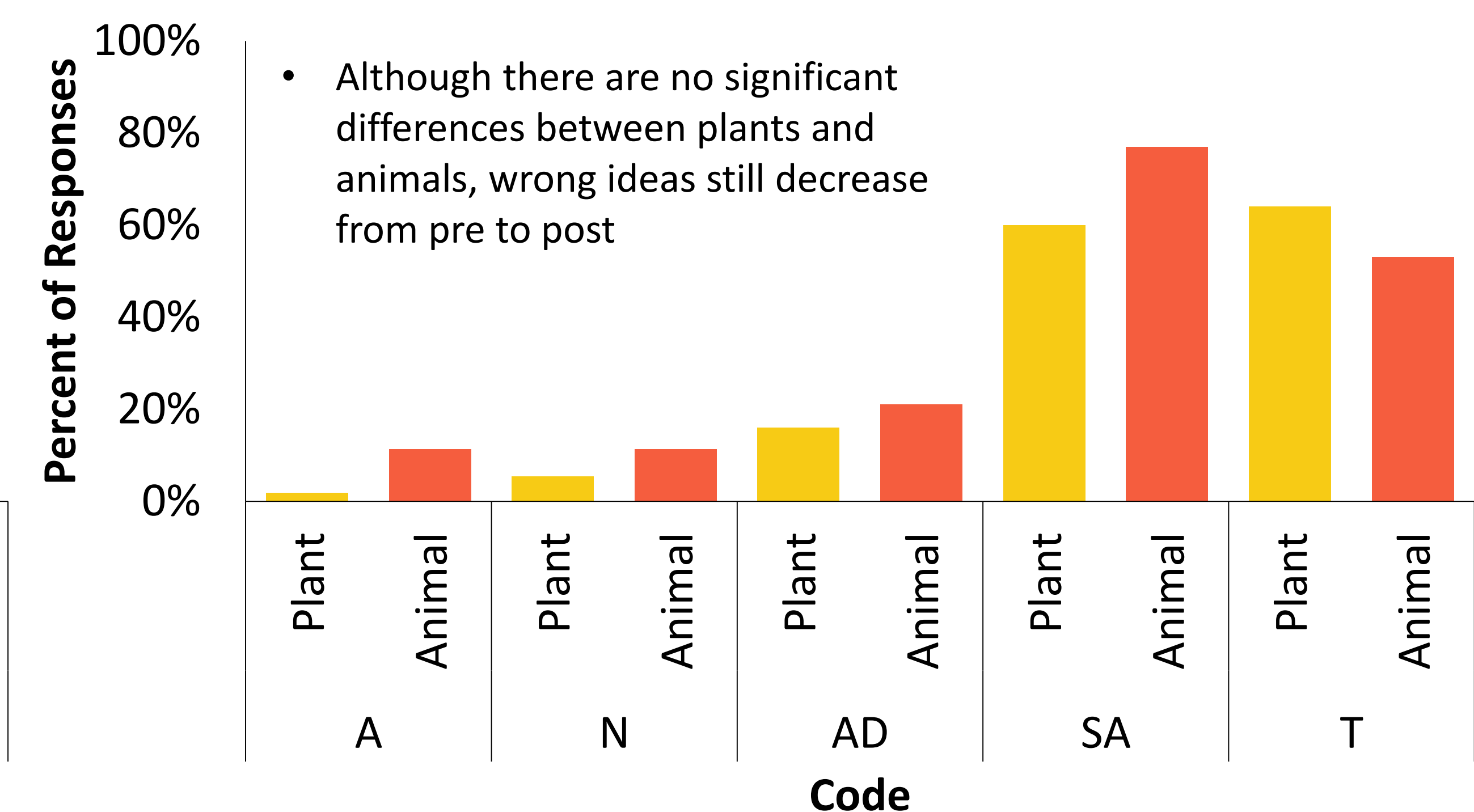
Evolution: Pre-Assessment ($n = 114$)



Intro Biology II: Post-Assessment ($n = 215$)



Evolution: Post-Assessment ($n = 108$)



Context matters... sometimes

- Students say more about animals
- Context plays more of a roll in introductory biology
- No significance in evolution because small sample size?

References

[1] Bishop (1990) Journal of Research in Science Teaching [2] Nehm (2007) Bioscience [3] Nehm (2012) The American Biology Teacher [4] Nehm (2010) academia.edu

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