Within-Species Comparisons

Danielle Sulikowski
Perception and Performance Research Group,
School of Psychology, Charles Sturt University,
Bathurst, NSW, Australia

Synonyms

Comparative analyses; Intraspecific comparisons

Definition

Comparative analyses between (groups of) individuals from the same species.

Introduction

Within-species comparisons refer to comparative analyses between (groups of) individuals from the same species. These may be naturally occurring groups within the same population such as males and females (Gur and Gur 2017), or juveniles and adults (Adjorlolo and Egbenya 2016; Lobue 2009), or groups comprised of individuals varying in other behaviorally relevant characteristics (such as sociality, Ashton et al. 2018, or personality, Roche et al. 2016). Useful comparisons may also be made between geographically or temporally discrete populations of the same species. Such populations may vary culturally (Apicella and Barrett 2016; Luncz et al. 2018) or along relevant environmental gradients (Roth and Pravosudov 2009; Van Lange et al. 2017). Within-species comparisons also occur in experimental settings, with individuals randomly allocated to different experimental groups (Sulikowski and Burke 2015). In all instances, within-species comparisons have the potential to inform on the function, evolution, development, and/or mechanistic bases of behavior. In appropriate contexts they can provide more exact tests of phylogenetic and evolutionary hypotheses than can between-species comparisons (Sulikowski 2016). With the exception of their use in experimental designs, however, within-species comparisons are nevertheless limited in the extents to which they can support causal conclusions about behavior and its underlying mechanisms.

Comparisons Between Naturally Occurring Groups

Comparisons between naturally occurring groups within a population are probably the most common types of within-species comparison and are the types that most readily come to mind as the "typical" within-species comparison. Such comparisons encompass investigations into sex differences, age cohort effects, and social group effects. Studies involving these types of

T. K. Shackelford, V. A. Weekes-Shackelford (eds.), *Encyclopedia of Evolutionary Psychological Science*,
https://doi.org/10.1007/978-3-319-16999-6_2230-1

comparisons are classed as quasi-experimental, since they involve comparisons between groups to which individuals a priori belong (as opposed to true experimental designs, in which individuals are randomly allocated to different groups).

Sex Differences

Sex differences in the brain and behavior are common in both humans and nonhuman animals (Gur and Gur 2017). These differences have proved important sources of data for evolutionary theories on a wide range of behaviors. While theories pertaining to reproductive behaviors are likely the most apparent beneficiary, sex differences have also informed evolutionary theories of foraging and perceptual priority. In this section I will use examples of these latter two applications to illustrate the broad utility of within-species male-female comparisons, for understanding the evolution of behavior.

Human sex differences in spatial cognition motivated the hunter-gatherer theory, which postulates that male advantages in allocentric navigation and female advantages in object location memory reflect the respective selection pressures on men and women, to optimize hunting and gathering efficiency (Silverman and Eals 1992). The hunter-gatherer theory does not purport to explain the totality of human sex differences in the brain and cognition but identifies one selection pressure – the need to maximize foraging efficiency – that would have applied differentially to the sexes. As men hunted and women foraged, differential selection pressures would have acted on the sexes to maximize foraging efficiency. By comparing men and women on a variety of tasks for which the hunter-gatherer theory predicts sex differences (including dead reckoning, Silverman et al. 2000, and proximal landmark-based navigation, Hughes et al. 2014), the extent to which selection pressures to maximize foraging efficiency are reflected in modern human cognition can be examined.

There is more information and stimuli available in the environment than any individual can attend to. As such individuals must allocate perceptual priority to some information/stimuli over others. Many studies have suggested that threatening, and other especially relevant, stimuli are prioritized in this manner. However, studies that simply compare the speed of recognition and response to threatening and non-threatening stimuli are open to the criticism that some innocuous feature(s) of the stimuli, rather than their threatening status per se, simply render some classes of stimuli easier to perceive for stochastic, nonadaptive reasons (Quinsey 2013). In this context, sex differences between men and women in how attention is allocated to weapons (Sulikowski and Burke 2014) and to foods with sex-specific nutritional value (Love and Sulikowski 2018) can confirm that the relevance of stimuli to individuals drives prioritized attention (as these effects of sex cannot be solely attributed to idiosyncratic features of the stimuli used).

Age Cohort Effects

Comparisons between adults and juveniles of a species can speak both to the developmental trajectories of behaviors and to experiential impacts on behavioral phenotypes. For example, children under 6 readily conflate whether or not something is physically possible, with whether or not it is allowed, while adults clearly differentiate these concepts (Shtulman and Phillips 2018); and it isn’t until after children are immunized (and have thus had an aversive experience with syringes) that they allocate prioritized visual attention to needles as a dangerous object (Lobue 2009).

Age cohort comparisons may also subserve more complex investigations, such as whether or not the same behavior appearing in juveniles and adults is supported by the same or different proximal mechanisms. For example, adult and older-adult sexual offenders tend to reliably exhibit executive function and intelligence deficits that distinguish them from non-sex offenders (Adjorlolo and Egbenya 2016), while juvenile sex offenders do not (Falligant et al. 2017). This implies that, for juveniles, sex offending is part of a broader pattern of delinquent behavior (Falligant et al. 2017), while in adults, it is indicative of sexually motivated behavioral dysfunction.

Sociality

Sociality has been proposed as one of the major evolutionary drivers of complex cognitive abilities – the social intelligence hypothesis. Most evidence supporting this theory has derived from comparisons between closely related species differing in sociality. More recent support has come from within-species comparisons of Australian magpies, where individuals living in larger groups exhibit superior cognitive performance compared to individuals living in smaller groups (Ashton et al. 2018).

In cases where between-species comparisons provide the majority of evidence bearing on a theory, as is the case with the social intelligence hypothesis, within-species comparisons can be especially valuable. Between-species comparisons are always vulnerable to alternative interpretations: any given pair, or set, of species will vary along many dimensions, not just in the trait of interest. Bird species differing in social group size may also differ in any number of other traits (mating system, foraging ecology, predation risk, etc.), potentially confounding comparisons of cognitive ability between species with differing levels of sociality. Within-species comparisons of individuals living in differently sized groups can minimize many of the phylogenetic and ecological confounds associated with between-species comparisons providing, in this case, especially strong support for the social intelligence hypothesis (Ashton et al. 2018).

Comparisons Along an Environmental Gradient

How individuals and populations respond to environmental selection pressures (in terms of both behavioral plasticity and evolutionary change) is key to the adaptive nature of behavior. When a single species resides along an environmental gradient, whether continuously or in discrete populations, within-species comparisons along this gradient can reveal quantitative changes in the brain and behavior associated with the changing environment.

One large-scale example of human behavior change along an environmental gradient is the observed increase in violence and aggression associated with warmer climates. Some notable exceptions aside (including Russia and South Africa, both of which are relatively far from the equator and exhibit high rates of violent crime), within and between countries, conflict and violent crime rates tend to be higher closer to the equator (Van Lange et al. 2017). This effect may be accounted for mechanistically by strong negative correlations between peripheral serotonin transporter density (low levels of which are associated with violence and impulsivity at the individual level) and ambient temperatures (Tiihonen et al. 2017).

A further example derives from the comparative literature. Black-capped chickadees occupy a large range across North America and rely heavily on supplies of cached food during the winter months. Accurate spatial memory, supported by the hippocampus, is required to recover these caches. As their range extends further north (away from the equator), the winters are harsher, and the birds are more heavily reliant on their cached winter stores. Comparisons of five populations of black-capped chickadees along this gradient of harshness revealed perfect rank-order correlations between both hippocampal volume and neuronal numbers, on the one hand, and increasing latitude on the other (Roth and Pravosudov 2009).

Within-species comparisons along environmental gradients take on a special significance in the context of global climate change. As temperatures rise, species will adapt (to the extent that they can, Butt et al. 2016). Comparisons along extant environmental gradients may reveal the capacities that different populations have to respond adaptively to increases in temperature and other associated climatic changes. They may also permit us to predict climate-induced behavioral changes at the population level. For example, mean increases in ambient temperatures of 2 °C have been predicted to result in a 3% increase in rates of violent assaults and murder across cold-temperate zones (Tiihonen et al. 2017).

Cross-Cultural Comparisons

Cross-cultural comparisons involve comparisons between groups of individuals from culturally diverse backgrounds. They are frequently used both to examine the effects of cultural influences on behavior (Apicella and Barrett 2016) and also to identify those traits that are culturally invariant, especially with respect to people (Buss 2001). Cross-cultural comparisons also extend to nonhuman animals. In this domain, research is more strongly focused on cultural differences, since such differences provide the requisite evidence that divergent animal cultures exist (Luncz et al. 2018). Indeed, within the context of evolutionarily motivated investigations of behavior, the key difference between human and nonhuman cross-cultural investigations is that, with respect to the former, there is an accepted presumption that the behavior of individuals from very different cultures is likely to vary accordingly. As such, demonstrations of cross-cultural consistency and generalizability of findings are highly sought, as evidence of a genetic or biological basis for behavior. In the context of nonhuman cultural investigations, far greater emphasis is placed on demonstrating social transmission within a group of a behavior that varies between groups as evidence that cultural effects on behavior exist.

Cross-Cultural Comparisons in Humans

A classic cross-cultural comparison of human behavior is found with Buss' (1989) study which assessed 37 samples from 27 countries across 6 continents and demonstrated remarkable cross-cultural consistency in human mate preference sex differences: women more strongly prize traits indicative resource acquisition potential, and men more strongly prize traits indicative of reproductive capacity. Against the backdrop of the standard social science model (SSSM, Tooby and Cosmides 1992), which posits that within-group consistencies and biases in human behavior result from culturally constructed norms and societal influences, consistency across cultures of behaviors, whose supposed cultural determinants vary widely across those cultures, offers especially compelling evidence for the adaptive nature of human behavior. For example, very high cross-cultural agreement on subjective judgments of facial attractiveness (Langlois et al. 2000) undermines claims that attractiveness is a social construct driven by the beauty ideals promoted in popular Western media.

The above is not to say that observed cultural differences in human behavior necessarily undermine evolutionary explanations of behavior. In fact evolutionary theories of behavior often predict cross-cultural differences. This often occurs in the context of predicting cross-cultural associations, at the level of the country between two or more variables. For example, Moore et al. (2013) report that women's preferences for facial cues of high testosterone are higher in countries with a low United Nations human development index and are also positively correlated with pathogen stress (at the country level). From this they suggest that women may facultatively adjust their preferences for male testosterone level, preferring more masculine male faces when environmental conditions are harshest.

Such conclusions about individual-level mechanisms drawn from group-level analyses, however, can be problematic. As Pollet et al. (2014) explain, there is no automatic concurrence of relationship between variables when measured at an individual, compared with at a group, level. To assume such a concurrence is known as the ecological fallacy. It is possible that two variables may correlate negatively across individuals within a group but positively across groups. Such a scenario is known as Simpson's paradox and has been empirically observed with respect to wealth and voter preferences in the Unites States. Within a state, wealthier individuals are more likely to vote Republican than Democrat, yet wealthier states are more likely to have a higher proportion of Democrat voters (Gelman et al. 2007). So while higher group-level associations can arise as a result of individual-level associations and mechanisms, without comparing both group-level and individual-level data, it is unwise to presume that the two will concur and have a common cause.

In the case of preferences for masculine faces in the face of environmental harshness, therefore, Moore et al.' (2013) country-level analysis, taken on its own, provides little convincing evidence of individual facultative responses to pathogens. However, other studies adopting experimental techniques have observed increased preferences for masculine faces after exposing participants to cues of environmental pathogens (Little et al. 2011). This suggests that Moore and colleagues' conclusions may well be correct but multilevel analyses of individual-level data nested within country-level data would be needed to determine whether such individual facultative responses to pathogens are all that is driving the country-level association (Pollet et al. 2014).

Cross-Cultural Comparisons in Nonhuman Animals

Cultural traditions in nonhuman animals, observed as stable between group differences in socially transmitted behaviors, have most commonly been identified and studied in primate species, particularly chimpanzees (Luncz et al. 2018). Unlike in humans, where cultural impacts on behavior are taken for granted, demonstrations of cultural divergence of behavior in nonhuman animals are received more critically. In addition, nonadaptive, stochastic proliferation of culture is often presumed to be unique to humans, with animal cultural divergences presumed to be adaptive responses to environmental differences between groups (Boyd and Richerson 1988) arising from individuals within a group relying on individual learning to arrive the local optimal solution to a problem (Laland and Janik 2006).

More recently, though, it has been demonstrated that some local chimpanzee nut-cracking cultures are sub-optimal, using less efficient nut-cracking methods than those seen in neighboring cultures. Critically, this is true even of adult chimpanzee females who immigrated into a group from a group with a more efficient nut-cracking strategy. That these females choose to adopt the less efficient strategy of their new community rather than persist with more efficient strategies with which they are familiar implies a personal cost to the individual that must be outweighed by the benefits of conforming to group norms (Luncz et al. 2018). Such cross-cultural investigations in nonhuman animals are therefore revealing similarities between human and nonhuman animal social behavior that could support the development of theories of nonadaptive cultural evolution and social conformity that are not anthropocentric.

Conclusion

Comparing how groups and individuals of the same species behave across different cultural, environmental, and social contexts and how behavior changes with age and sex affords tremendous power to understand the evolution, function, and mechanistic bases of behavior. When incorporated into experimental designs, they can support direct causal conclusions about behavior. Whether considering human or nonhuman animal behavior, within-species comparisons alleviate the confounds associated with between-species comparative analyses, providing more robust tests of the hypotheses at hand.

Cross-References

- ▶ Comparative Evidence
- ▶ Cross-Cultural Similarities
- ▶ Cross-Cultural Variation
- ▶ Sex Differences
- ▶ The Field of Comparative Psychology

References

Adjorlolo, S., & Egbenya, D. L. (2016). Executive functioning profiles of adult and juvenile male sexual offenders: A systematic review. *The Journal of Forensic Psychiatry and Psychology, 27*, 349–375.

Apicella, C. L., & Barrett, H. C. (2016). Cross-cultural evolutionary psychology. *Current Opinion in Psychology, 7*, 92–97.

Ashton, B. J., Ridley, A. R., Edwards, E. K., & Thornton, A. (2018). Cognitive performance is linked to group size and affects fitness in Australian magpies. *Nature, 554*, 364. https://doi.org/10.1038/nature25503.

Boyd, R., & Richerson, P. J. (1988). *Culture and the evolutionary process*. Chicago: University of Chicago Press.

Buss, D. M. (1989). Differences in human mate preferences: Evolutionary hypotheses tested in 37 cultures. *Behavioural and Brain Sciences, 12*, 1–49.

Buss, D. M. (2001). Human nature and culture: An evolutionary psychological perspective. *Journal of Personality, 69*, 955–978.

Butt, N., Possingham, H. P., De Los Rios, C., Maggini, R., Fuller, R. A., Maxwell, S. L., & Watson, J. E. M. (2016). Challenges in assessing the vulnerability of species to climate change to inform conservation actions. *Biological Conservation, 199*, 10–15.

Falligant, J. M., Alexander, A. A., & Burkhart, B. R. (2017). Offence characteristics and cognitive functioning in juveniles adjudicated for illegal sexual behaviour. *Journal of Sexual Aggression, 23*, 291–299.

Gelman, A., Shor, B., Bafumi, J., & Park, D. (2007). Rich state, poor state, red state, blue state: what's the matter with Connecticut? *Quarterly Journal of Political Science, 2*, 345–367.

Gur, R. C., & Gur, R. E. (2017). Complementarity of sex differences in brain and behaviour: From laterality to multimodal neuroimaging. *Journal of Neuroscience Research, 95*, 189–199.

Hughes, M. A., Sulikowski, D., & Burke, D. (2014). Correlations between spatial skills: A test of the hunter-gatherer hypothesis. *Journal of Evolutionary Psychology, 12*, 19–44.

Laland, K. N., & Janik, V. M. (2006). The animal cultures debate. *Trends in Ecology & Evolution, 21*, 542–547.

Langlois, L. K., Rubenstein, A. J., Larson, A., Hallam, M., & Smoot, M. (2000). Maxims or myths of beauty? A meta-analytic and theoretical review. *Psychological Bulletin, 126*, 390–423.

Little, A., Debruine, L. M., & Jones, B. C. (2011). Exposure to visual cues of pathogen contagion changes preferences for masculinity and symmetry in opposite-sex faces. *Proceedings of the Royal Society B, 278*, 2032–2039.

Lobue, V. (2009). What's so scary about needles and knives? Examining the role of experience in threat detection. *Cognition & Emotion, 24*, 180–187.

Love, H. J., & Sulikowski, D. (2018). Of meat and men: Sex differences in implicit and explicit attitudes towards meat. *Frontiers in Psychology*. https://doi.org/10.3389/fpsyg.2018.00559.

Luncz, L. V., Sirianni, G., Mundry, R., & Boesch, C. (2018). Costly culture: Differences in nut-cracking efficiency between wild chimpanzee groups. *Animal Behaviour, 137*, 63–73.

Moore, F. R., Coetzee, V., Contreras-Garduno, J., Debruine, L. M., Kleisner, K., Krams, I., Marcinkowska, U., Nord, A., Perrett, D. I., Rantala, M. J., Schaum, N., & Suzuki, T. N. (2013). Cross-cultural variation in women's preferences for cues to sex- and stress-hormones in the male face. *Biology Letters, 9*, 20130050.

Pollet, T. V., Tybur, J. M., Frankenhuis, W. E., & Rickard, I. J. (2014). What can cross-cultural correlations teach us about nature? *Human Nature, 25*, 410–429.

Quinsey, P. T. (2013). The visual detection of threat: A cautionary tale. *Psychonomic Bulletin & Review, 20*, 1080–1101.

Roche, D. G., Careau, V., & Binning, S. A. (2016). Demystifying animals 'personality' (or not): Why it matters to experimental biologists. *Journal of Experimental Biology, 219*, 3832–3843. https://doi.org/10.1242/jeb.146712.

Roth, T. C., & Pravosudov, V. (2009). Hippocampal volumes and neuron numbers increase along a gradient of environmental harshness: A large-scale comparison. *Proceedings of the Royal Society of London B, 276*, 401–405.

Shtulman, A., & Phillips, J. (2018). Differentiating "could" from "should": Developmental changes in modal cognition. *Journal of Experimental Child Psychology, 165*, 161–182.

Silverman, I., & Eals, M. (1992). Sex differences in spatial abilities: Evolutionary theory and data. In I. Barkow, L. Cosmides, & J. Tooby (Eds.), *The adapted mind: Evolutionary psychology and the generation of culture* (pp. 487–503). New York: Oxford University Press.

Silverman, I., Choi, J., Mackewn, A., Fisher, M., Moro, J., & Olshansky, E. (2000). Evolved mechanisms underlying wayfinding: Further studies on the hunter-gatherer theory of spatial sex differences. *Evolution and Human Behavior, 21*, 201–213.

Sulikowski, D. (2016). Floral cognition: Comparative and functional perspectives. In M. Olmstead (Ed.), *Animal cognition: Principles, evolution and development* (pp. 107–129). New York: Nova Science Publishing.

Sulikowski, D., & Burke, D. (2014). Threat is in the sex of the beholder: Men find weapons faster than do women. *Evolutionary Psychology, 12*, 888–906.

Sulikowski, D., & Burke, D. (2015). Noisy miners plan ahead: Cryptic signalling of reward location impairs search for nectar, but not for invertebrates. *Animal Behaviour, 102*, 140–155.

Tiihonen, J., Halonen, P., Tiihonen, L., Kautiainen, H., Storvik, M., & Callaway, J. (2017). The association of ambient temperature and violent crime. *Scientific Reports, 7*, 6543. https://doi.org/10.1038/s41598-017-06720-z.

Tooby, J., & Cosmides, L. (1992). The psychological foundations of culture. In I. Barkow, L. Cosmides, & J. Tooby (Eds.), *The adapted mind: Evolutionary psychology and the generation of culture* (pp. 19–136). New York: Oxford University Press.

Van Lange, P. A. M., Rinderu, M. I., & Bushamn, B. J. (2017). Aggression and violence around the world: A model of climate, aggression, and self-control in humans (CLASH). *Behavioral and Brain Sciences*, e75. https://doi.org/10.1017/S0140525X16000406.