Trends and determinants of active school travel among Australian secondary school students: national cross-sectional data from 2009 to 2018

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Physical activity has important health benefits for children, including reducing overweight/obesity and depression and increasing bone mineral density.[1] Active school transport, or active travel between destinations by walking, cycling or other non-motorised modes, is a potential source of regular physical activity for children.[2] A systematic review found students (primary and secondary) who actively travelled recorded at least 20 minutes of additional moderate to vigorous physical activity per day, compared to passive travellers.[2] Active travel also helps reduce pollution and CO_2 emissions, in turn contributing to efforts to address climate change.[3]

Despite these benefits, rates of school-related active travel have been declining for decades globally,[4] including due to suburbanisation (shift from urban areas to suburbs resulting in increased urban sprawl), and a decline in 'within area' school enrolments.[5]

Studies on active travel trends in Australia have either focused on primary school students,[6] have not differentiated between primary and secondary students, and/or have been state-based rather than national.[7,8] A New South Wales (NSW) study found the rate of active travel among primary and secondary

students remained stable between 2004 and 2010.[9] Data from the 2015 NSW School Physical Activity and Nutrition Survey (SPANS) reported no change in active travel among secondary students between 2010 and 2015 (14.4% vs. 14.1%), although a non-statistically significant decrease among primary school students from 19.3% to 14.7% was found.[8] Other studies have also reported declines in active travel among primary school students.

Among 9–13-year-olds in Melbourne (Victoria) between 1985 and 2001, walking to or from school declined from 4.4 mean trips per week to 3.6 ($p<0.001$).[10] Among 5–9-year-olds and 10–14-year-olds in NSW between 1971 and 2003, the percentage of children walking to school declined from 58% to 26% ($p<0.05$), and 44% to 21% ($p<0.05$), respectively.[11]

Abstract

Objective: To examine active school travel trends and predictors among Australian secondary school students (aged 12–17) between 2009 and 2018.

Methods: Three cross-sectional surveys (2009-10: N=13,790; 2012-13: N=10,309; and 2018: N=9,102) using a web-based self-report questionnaire. Logistic regression was used to identify differences in active travel (to and/or from school every weekday) between survey years and predictors.

Results: From 2009-10 to 2012-13 to 2018, active travel decreased from 33.6% to 32.3% to 29.5% among females, and from 37.4% to 36.6% to 32.6% among males. Distance, female sex and regional location were associated with a lower likelihood of active travel. Students with pocket money, those who spoke a language other than English at home, and Aboriginal and/or Torres Strait Islander students were more likely to actively travel.

Conclusions: Between 2009-10 and 2018, active school travel among secondary students in Australia declined. Several factors were found to be associated with active travel.

Implications for public health: This is the first national study on active travel trends among secondary students in Australia. The recent decline requires action given the increasing prevalence of overweight and climate change.

Key words: active transport, adolescents, Australia, active travel, school

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The transition from primary to secondary school is significant with respect to physical activity, as lifelong patterns are established.[12] Some studies suggest active travel may increase during the transition from primary to secondary school due to increased independent mobility.[13,14] However, a 2018 nationally representative Australian survey found that 23% of primary students (5–12 years) usually travelled to/from school, compared to only 16% of secondary students (13–18 years).[15] It is therefore important to analyse active travel among secondary students separately. There is a gap regarding recent national data on active travel trends among secondary school students in Australia.

It has been observed that the correlates of active travel in Australia may be different to those found in countries with higher rates of active travel.[16] There have been a limited number of studies that have examined factors associated with active travel among Australian school children.[6,17-22] Of the studies that have been done, distance to school was the most consistent predictor of active travel – with greater distance inversely related to rates of active travel.[6,17-22] Most Australian studies examining correlates of active school travel only included primary school children, with few exceptions.

Of Australian studies that have examined correlates of active travel among secondary students, Leslie et al. (2011) found that the following were associated with a greater likelihood of active travel: male sex, higher perceived safety of the neighbourhood, and higher perceived community disorder (considered to be from observations while actively travelling).[23] However, schools from only three states in Australia were sampled, and the study did not disaggregate grade 6 (primary school) and grade 8 (secondary school) students. Carver et al. (2013) surveyed parents and primary and secondary students from years 3–6 and 7–10 in Victoria, and found that the following factors were associated with greater car travel to school: greater distance to school from home, lower social trust, expressed concern about injury while crossing a road, rural location, attendance at primary school, female sex, lower age of child, and at least one parent not employed full-time.[17] However, the response rates were modest (parents=18.5%, students=14.3%) and did not capture students from Catholic or independent schools.[17] The NSW SPANS study found that

the prevalence of active travel was higher among students from rural areas.[8] None of the studies reviewed included national data. The paucity of national Australian data regarding correlates of active travel has been noted by other authors,[16] and the lack of data on secondary school students, in particular, is of concern.

The aim of the present study is to examine whether the rate of active travel has changed among Australian secondary school students aged 12–17 years surveyed in separate cross-sectional surveys at three times points: 2009-10, 2012-13 and 2018. The study also examines whether various individual and group demographic, health, social and environmental factors are associated with active travel using the combined responses from the three surveys.

Methods

Design and procedure

Data were obtained from students participating in the three waves of the cross-sectional National Secondary Students' Diet and Activity (NaSSDA) survey. Students aged 12–17 years from years 8 to 11 across Australia were surveyed in 2009-10 (N=13,790), 2012-13 (N=10,309) and 2018 (N=9,102). The sampling procedure used a stratified two-stage probability design, with schools randomly selected at the first stage of sampling and classes selected within schools at the second stage. Within each state and territory, schools were stratified by the three education sectors (government, Catholic and independent) and randomly selected from each sector to ensure that the distribution of schools by sector within each state or territory was reflected in the sample.

Variables

Active travel to/from school was assessed with the following questions: "How do you travel to school/home from school in a usual week? (Please indicate the number of days you use each type of transport. If you use more than one type of transport to get to school, please indicate each type. If you don't use a type of transport to get to school, please click on zero.)" The types of transport listed were: Walk; Public transport (e.g. bus, train, tram, ferry/boat); Cycle; Car; Skateboard/scooter (2018 only, not included in analysis). The dependent (outcome) variable for this study was active travel, defined as travelling

to and/or from school either by walking or cycling every weekday.

Predictor covariates (self-reported by students) examined included: sex, school year level, amount of pocket money to spend on food/drinks/snacks, part-time job status, agree with the statement 'I feel safe walking or riding my bike in my neighbourhood during the day', agree with the statement 'It is too far for me to walk or ride my bike to school', main language spoken at home, self-reported health status, and Aboriginal and/or Torres Strait Islander status. The following information was designated by researchers: survey year (exposure variable for aim 1), state/territory, school type (government, Catholic and independent), consent type (active or passive) and area socio-economic status (SES). Area SES was determined by the home postcode provided by students and defined according to the Socio-Economic Index for Areas Index of Relative Socio-economic Disadvantage.[24] SES categories were created using national percentiles to create tertiles, and students were categorised into low SES (1–33%), mid SES (34–67%), and high SES (68–100%). Home postcode also determined rural/remote residence, based on the Australian Statistical Geography Standard Remoteness Structure.[25]

Statistical methods

Data were analysed using Stata MP V.16.1 (StataCorp, College Station, Texas). Demographic characteristics were compared between survey years using chi-squared tests. To determine differences in active travel between 2009-10, 2012-13 and 2018, the percentage of students who actively travelled was compared between survey years and stratified by sex. Odds ratios were obtained for sex-stratified differences in active travel between survey waves (study aim 1). Models for both male and female students adjusted for area SES, remoteness, Aboriginal and/or Torres Strait Islander status, school year level, language spoken at home, perception of safety, perception of distance, education sector, consent type and state. In addition, the model for female students adjusted for pocket money for food/drinks/snacks, and the model for male students adjusted for school year level. For study aim 2, predictors of active travel (combined survey waves) were determined using multilevel logistic regression with school as the random effect.

Multivariate logistic regression was preceded by univariate analyses and utilised a stepwise

backward elimination process. Variables with *p*-values <0.25 were kept in full models, and variables with *p*-values <0.05 were kept in final models.

Description of the sample

Characteristics of the students surveyed in Wave 1 (2009-10), Wave 2 (2012-13) and Wave 3 (2018) are shown in Table 1. The mean and standard deviation of the Index of Relative Socio-economic Disadvantage national percentile based on student home postcode for Wave 1=56.07±28.42, Wave 2=55.43±29.68 and Wave 3=55.69±28.84. Notable differences between survey years included an increase in the proportion of students who reported mainly speaking a language other than English at home, and a decline in the proportion of students who reported feeling safe actively travelling in their neighbourhood.

Results

Changes in active travel between survey waves

The proportion of female and male secondary school students who actively travelled (walked/cycled) to and/or from school every weekday in Australia decreased between 2009-10 and 2018 (Table 2). In all three survey years, the overall proportion of male students who actively travelled was higher than female students.

After adjustment, female secondary school students were 25% less likely to actively travel to and/or from school every weekday in 2018 than in 2009-10 (OR, 0.75; 95%CI, 0.60-0.93). After adjustment, male students were 31% less likely to actively travel in 2018 than in 2009-10 (OR, 0.69; 95%CI, 0.55-0.86); see Table 2.

Individual, social and environmental factors associated with active travel – survey waves combined

Male and female data were pooled in Table 3, as the factors associated with active travel were largely similar between male and female students. However, a noteworthy difference in the univariate analyses by sex was observed in relation to safety. Male students who agreed with the statement 'I feel safe walking or riding my bike in my neighbourhood during the day', were 11% more likely to actively travel than those who did not agree with the statement (OR, 1.11; 95%CI, 1.02-

1.20), while female students who agreed with the statement were 21% more likely to actively travel compared to those who did not agree with the statement (OR, 1.21; 95%CI, 1.12-1.30).

In the multivariate analysis, agreeing with the statement 'It is too far to ride/walk to school' had the strongest association with reduced likelihood of active travel (OR, 0.37; 95%CI, 0.35-0.39). Aboriginal and/or Torres Strait Islander students were 33% more likely to actively travel than those who were not Aboriginal and/or Torres Strait Islander (OR, 1.33; 95%CI, 1.17-1.51). Students who had pocket money for food, drinks and snacks were more likely to actively travel. Self-

reported health status and part-time job status were not associated with active travel.

Discussion

This study provides the first national overview of active school travel among secondary school children in Australia, using three surveys over the nine-year period 2009-10 to 2018, and an examination of associated factors. It found that both female and male Australian secondary students were less likely to actively travel to/from school every weekday in 2018 compared to 2009-10. This finding is consistent with some earlier state

Table 1: Characteristics of Australian secondary school students surveyed in 2009-10, 2012-13 and 2018.

Survey year	2009-10 N=13,790 % (n)	2012-13 N=10,309 % (n)	2018 N=9,102 % (n)	χ² *p*-value
Individual (student self-report)				
Sex (female)	49.3 (6793)	50.1 (5169)	52.1 (4739)	<0.001
Aboriginal and/or Torres Strait Islander	4.2 (579)	5.2 (534)	5.9 (538)	<0.001
Other (non-English) language spoken at home	9.5 (1309)	10.8 (1109)	13.9 (1267)	<0.001
Poor self-reported health status	1.8 (253)	1.6 (166)	2.7 (249)	<0.001
Part-time employment (student)	29.6 (4087)	30.9 (3182)	31.1 (2827)	0.035
No pocket money to spend on food/drinks/snacks (student)	14.9 (1829)	20.1 (1768)	18.6 (1352)	<0.001
Social-environmental (based on student home postcode)				
Most disadvantaged area socio-economic status category	25.6 (3504)	27.6 (2846)	25.6 (2330)	<0.001
Regional/remote geographical location	38.3 (5251)	42.4 (4373)	34.7 (3159)	<0.001
Built environment (student self-report)				
Agree with the statement: I feel safe walking or riding my bike in my neighbourhood during the day	75.2 (10312)	69.4 (6961)	67.3 (6064)	<0.001
Agree with the statement: It is too far for me to walk or ride my bike to school	46.4 (6360)	48.4 (4851)	48.5 (4367)	0.001

Table 2: Australian secondary school students actively travelling to and/or from school every weekday in 2012-13 and 2018, compared to 2009-10: proportions, unadjusted and adjusted odds ratios, by sex.

	Active travel[a] every weekday % (n)	Unadjusted (active travel[a] every weekday) OR (95%CI)	P	P overall[d]	Adjusted[b,c] (active travel[a] every weekday) OR (95%CI)	P	P overall[d]
Female							
2009–10	33.6 (2283)	ref		0.059	ref		**0.031**
2012–13	32.3 (1669)	0.97 (0.83–1.14)	0.746		0.99 (0.86–1.14)	0.932	
2018	29.5 (1395)	0.81 (0.67–0.97)	**0.021**		0.75 (0.60–0.93)	**0.010**	
Male							
2009–10	37.4 (2619)	ref		**0.030**	ref		**0.001**
2012–13	36.6 (1882)	1.01 (0.87–1.18)	0.867		1.04 (0.91–1.19)	0.568	
2018	32.6 (1419)	0.80 (0.67–0.96)	**0.017**		0.69 (0.55–0.86)	**0.001**	

Notes:

a: Active travel defined as walking and/or cycling to and/or from school every weekday

b: Walk/cycle everyday (females) model adjusted for: area SES, remoteness, Aboriginal and/or Torres Strait Islander status, perception of safety, perception of distance, pocket money for food/drinks/snacks, education sector, consent type, state and school clustering.

c: Walk/cycle everyday (males) model adjusted for: area SES, remoteness, Aboriginal and/or Torres Strait Islander status, school year level, main language spoken at home, perception of safety, perception of distance, education sector, consent type, state and school clustering.

d: P overall for Wald test for variables with >2 categories

and city-based studies among Australian primary or combined primary and secondary students.[9-11]

Students reporting that 'it is too far for me to walk or ride my bike to school' were the least likely to actively travel. This is consistent with international evidence that increased perceived and actual distance from school is a strong predictor of lower use of active travel.[26,27] Students in metropolitan areas were more likely to actively travel than students in regional and remote areas (even after adjustment for perception of distance

being too far), which other authors have found may be related to a greater likelihood of living closer to school.[20] However, Carver et al. (2013) found that more than half of students (n=688, years 3–10) in metropolitan areas (Victoria, Australia) did not attend the closest possible school to their home because of parental preference.[17] Choice of schools based on preference and not proximity represents a significant generational change in Australia over recent decades – a 2017 Victorian Auditor-General's school infrastructure report found that for the first

time in history, more than 50% of school enrolments came from outside the local school catchment.[28]

In each survey wave, a greater proportion of male students actively travelled to school compared to female students. This is consistent with previous Australian studies.[23] The gender difference could be explained by a multitude of factors.[23] One Australian study found that male secondary students are granted parental permission to actively travel more readily than female students.[29] Another factor is safety or perceived safety

Table 3: Predictors of active travel among Australian secondary school students in combined 2009–10, 2012–13 and 2018 surveys: univariate and multivariate analyses.						
	Active travel	Univariate analysis			Multivariate analysis[a]	
	% (n)	OR (95%CI)	P	P overall[b]	OR (95%CI)	P	P overall[b]
Sex							
Male	35.9 (5920)	ref			ref		
Female	32.0 (5347)	0.81 (0.77-0.85)	<0.001		0.88 (0.83-0.94)	<0.001	
Survey year				0.011			0.003
2009-10	35.6 (4902)	ref			ref		
2012-13	34.4 (3551)	0.98 (0.85-1.12)	0.758		1.00 (0.89-1.13)	0.998	
2018	31.0 (2814)	0.79 (0.67-0.93)	0.004		0.71 (0.59-0.87)	0.001	
Area socio-economic status (categories)[c]				0.023			0.311
Low	36.4 (3158)	ref			ref		
Mid	32.6 (3641)	0.91 (0.83-0.98)	0.020		0.94 (0.86-1.03)	0.219	
High	33.4 (4422)	0.89 (0.81-0.97)	0.009		0.93 (0.84-1.02)	0.140	
Remoteness (home location)							
Metropolitan	36.7 (7457)	ref			ref		
Regional/remote	29.6 (3776)	0.83 (0.75-0.92)	<0.001		0.83 (0.74-0.94)	0.002	
School year				0.003			0.023
8	33.0 (3210)	ref			ref		
9	34.4 (3214)	1.08 (1.01-1.16)	0.019		1.04 (0.97-1.12)	0.276	
10	35.5 (2762)	1.14 (1.06-1.22)	<0.001		1.13 (1.04-1.22)	0.004	
11	32.9 (2081)	1.06 (0.98-1.14)	0.180		1.02 (0.93-1.12)	0.647	
Aboriginal and/or Torres Strait Islander status							
No	33.5 (10576)	ref			ref		
Yes	41.9 (691)	1.40 (1.25-1.57)	<0.001		1.33 (1.17-1.51)	<0.001	
Main language spoken at home							
English	33.1 (9759)	ref			ref		
Other	40.8 (1501)	1.10 (1.01-1.19)	0.025		1.15 (1.05-1.26)	0.003	
Feel safe to walk/ride in daytime							
No	32.3 (3041)	ref			ref		
Yes	34.6 (8084)	1.18 (1.11-1.24)	<0.001		1.12 (1.05-1.19)	<0.001	
Believe it is too far to walk/ride to school							
No	45.0 (7728)	ref			ref		
Yes	21.8 (3394)	0.35 (0.34-0.37)	<0.001		0.37 (0.35-0.39)	<0.001	
Pocket money to buy food/drinks/snacks in a typical week				<0.001			0.008
$0	30.0 (1484)	ref			ref		
< $5	33.6 (2406)	1.14 (1.05-1.24)	0.001		1.14 (1.05-1.25)	0.002	
$5-$9	35.4 (2328)	1.20 (1.11-1.31)	<0.001		1.18 (1.08-1.28)	<0.001	
$10-$19	34.4 (1783)	1.14 (1.05-1.25)	0.003		1.08 (0.99-1.19)	0.091	
$20-$29	36.3 (886)	1.23 (1.11-1.38)	<0.001		1.18 (1.05-1.32)	0.005	
$30-$39	35.2 (300)	1.16 (0.99-1.37)	0.068		1.09 (0.92-1.29)	0.331	
$40+	37.2 (415)	1.24 (1.07-1.43)	0.004		1.09 (0.94-1.27)	0.244	

Notes:

a: Adjusted for covariates included in the final model, including all covariates in table plus consent type, education sector, state and school clustering.

b: P overall for Wald test for variables with >2 categories.

c: Low=1-33%, Mid=34-67%, High=68-100%.

concerns among female students. Our study found that male students who agreed with the statement 'I feel safe walking or riding my bike in my neighbourhood during the day' were 11% more likely to actively travel than those who did not agree with the statement, while female students who agreed with the statement were 21% more likely to actively travel compared to those who did not agree with the statement. These results reflect the findings from a previous study.[20] Interestingly, the proportion of both male and female students who agreed with this statement declined between 2009-10 and 2018.

The finding that Aboriginal and/or Torres Strait Islander students are more likely to actively travel than non-Aboriginal and/or Torres Strait Islander students is consistent with national data that indicates that Aboriginal and Torres Strait Islander children aged 5–17 years are more physically active than their non-Aboriginal and Torres Strait Islander counterparts.[30]

Speaking a language other than English at home was associated with a higher likelihood of active travel, and the proportion of students that spoke a language other than English at home increased with each survey wave. However, adjusting for this variable in the regression analyses did not change the overall decline in active travel between 2009-10 and 2018. The association of speaking a language other than English at home with active travel could be due to cultural differences related to attitudes towards transport use.[26,31]

The present study is the first of which we are aware that finds pocket money for food, drinks and snacks associated with a higher likelihood of active travel in Australia. This association could reflect students who use active travel bringing money to purchase snacks en route, or using loose change from purchasing public transport tickets, as there are food purchasing opportunities on their school journey. Alternatively, students who have pocket money may choose to actively travel, so they can purchase snacks en route. Australian children are exposed to high levels of outdoor advertising for unhealthy food and drink on school routes,[32] with exposure to unhealthy food advertising known to encourage a preference for and purchasing of unhealthy foods by children.[33] International studies have found that among adolescents, active travel is associated with an increased likelihood of consumption of fast food compared to car travel, related to higher fast-

food purchasing opportunities.[34,35] Secondary students with pocket money are more likely to consume fast food (overall) than those with no pocket money.[36] Interventions to increase active travel should also mitigate the potential unintended consequences related to increased exposure to unhealthy food marketing and environments along the school journey.

Various reasons for the lack of impact of active travel interventions in Australia have been identified. A 2008 randomised controlled trial of 24 Sydney primary schools found that the factors influencing active travel are complex and inter-related and that interventions are unlikely to succeed if they fail to address influencing factors outside of the school and council environment, such as parental travel behaviour (e.g. parent journey to work, during which they may drive their child to school).[37] The authors also note the opportunity to increase active travel through promoting the climate co-benefits.[37]

There is recent momentum regarding active school travel in Australia, including through the Australian Health Policy Collaboration's 'Active Travel: Pathways to a Healthy Future' report,[38] the Obesity Policy Coalition and Deakin University's Global Obesity Centre's 'Tipping the Scales' consensus statement,[39] and the Australian Government's 'National Obesity Prevention Strategy'.[40] Among the actions called for include: increased investment in facilitating infrastructure;[36] incentivisation of active travel;[37] the establishment of a virtual knowledge hub to promote information exchange;[35] dedicated funding to create safe, active zones around schools;[35] and coordinated national, state and council policies.[35] Promoting partial active travel (such as disembarkation from public transport a few stops early, or parking some distance from school) is important, particularly for students attending independent/Catholic schools who may live further from the school.

Interventions to increase active school travel should also consider the following: i) specific activities targeting adolescents, in line with previous calls from experts;[41] ii) tailored strategies to address gender-related barriers among female secondary school students, including addressing safety concerns; iii) inclusion of an equity focus into the intervention design, with consideration of SES, cultural background, regional location, and the inter-relationships between these factors; and iv) increased emphasis on the

health and climate co-benefits of active travel, potentially particularly effective among adolescents.[42] 'Future health' is not a motivator for adolescents, therefore traditional active travel interventions that don't address intrinsic motivations may have limited success.[43] 'Stealth interventions' activate intrinsic motivators linked to social movements to realise health benefits, without explicitly referencing behaviour change.[43] Explicitly framing active travel as a climate action offers a potential approach for engaging adolescents.

The health promotion sector would benefit from learning more about successful physical activity programs involving Aboriginal and Torres Strait Islander children and investing in robust systems to document and disseminate best practice. This builds on previous recommendations to improve the dissemination of publicly accessible details of physical activity programs involving Aboriginal and Torres Strait Islander people, in order to ensure best practice and culturally appropriate interventions.[44]

This study has several limitations. Data was not collected related to several variables previously associated with less likelihood of active travel among adolescents. For example, having at least one parent not employed full-time, low peer support,[17] high household income and car ownership.[26] School response rates were relatively low and declined with each of the surveys: 2009-10 = 39%; 2012-13 = 21%; 2018 = 8%, introducing the potential for nonresponse bias. However, implications for the representativeness of each of the samples are somewhat ameliorated by the selection of replacement schools from the same sector and postcode. The sample is not representative of the Aboriginal and Torres Strait Islander student population, and therefore findings, while noteworthy, are not necessarily generalisable. Much of the data was self-reported by students, introducing potential recall and social desirability bias. Distance between school and home was self-reported and therefore subjective, although studies with objective measures yielded similar results.[6,17-19] The consent process changed from active to either active or passive (as per the requirements of each individual state and territory education authority) in the third survey round; however, consent type was adjusted for in the final analysis. The study only examined active travel via walking or cycling. This will not capture students who were travelling via a

combination of other methods (e.g. walking combined with public transport). This study aggregated modes of active travel; however, predictors of each distinct mode may differ. The lack of a standard definition for active travel has been noted as a limitation by other authors.[45] This study defined active travel as actively travelling to and/or from school every weekday, in line with the Australian Department of Health's 'Australian 24-Hour Movement Guidelines for Children and Young People (5–17 years)'. Different results may have been obtained if a different definition of active travel was utilised.

Conclusion

This large, national survey found that secondary school students in Australia actively travelled less in 2018 than they did in 2009-10. This is of public health importance given the continued increase in overweight among Australian children,[46] and the potential of active travel as a source of regular physical activity for children,[2] which has been shown to reduce childhood overweight/obesity.[1] Active travel also helps reduce pollution and CO_2 emissions, in turn contributing to efforts to address climate change.[3] More understanding is required in relation to the inter-relationships of the predictors of active travel among secondary school students, including gender, SES, cultural background and regional location. Active school travel interventions that specifically target secondary students are recommended.

Acknowledgements

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