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School Speed Zones - What is Really Happening ?

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Abstract:

This study explores the effectiveness of school speed zone signage in New South Wales Speeds of vehicles travelling through the zones were measured during the signs operation and compared with periods outside the times when the signs operated. The data were analysed to determine whether the signage had any significant effect on traffic speeds. In addition, a survey of households near the study sites questioned drivers on their attitudes towards school speed zones. The direct measurements showed that signs were ineffective at most sites and even when they had some effect it was generally slight Attitudes of drivers revealed in the interview survey indicated that campaigns to improve the effectiveness of school speed zones, and lower speeds in residential neighbourhoods in general, must focus on driver psychology rather than rely solely on signage or physical infrastructure.

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Introduction

School speed zones have now been implemented throughout New South Wales as well as in other states. The zones are delineated by signs which indicate to motorists a maximum legal speed in the zone at specified times which is different from the speed limit that applies outside those times. In urban areas the general speed limit is normally 60 kilometres per hour, and this is reduced to 40 kilometres per hour during the times of operation of the sign. In rural areas some school zones reduce legal speed limits from between 80 and 100 kilometres per hour to 60 kilometres per hour. Although such signage is less expensive to implement at an individual site than other means of calming traffic or constraining vehicle speeds, the erection of sets of such signs at thousands of locations around the state represents a considerable investment by traffic authorities. The research reported here set out to demonstrate whether authorities are getting a satisfactory return on that investment in terms of changes in driver behaviour and improved safety for school children.

How can the effectiveness of school speed signs be gauged? The most direct measure would be in reduction of casualties around schools, (noting these are very low) but this would require a very complex data reporting system, involving vehicle speeds, times and death or injury statistics. We have opted for a study which measures reduction in vehicle speeds through school speed zones as a surrogate for safe operation. How can the effectiveness of the signs be gauged? We define three degrees of effectiveness:

- *Highly effective*, when at least 85% of drivers slow down, as a result of the signs, to a speed at, or lower than, the posted limit for the zone (usually 40 kilometres per hour).
- *Moderately effective*, when at least 50% of drivers slow down, as a result of the signs, to a speed at, or lower than, the posted speed limit.
- *Slightly effective*, when the presence of the signs induces some slowing of traffic, notwithstanding that such slowing does not bring even median speeds down to or below the posted speed limit.

Are signs sufficient control, or are there deep-seated attitudes in drivers which need to be addressed to achieve greater safety of children? By surveying the attitudes of drivers in households within one kilometre of the school zoned observed, the study was also designed to throw light onto these questions.

The studies

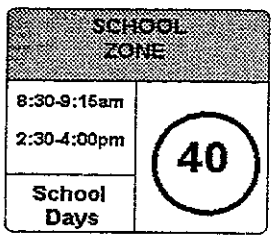
In early 1993, the New South Wales Government implemented school speed zone signage at primary and infants schools. Some high schools were also included. In December 1993 a pilot study was carried out on four sites in Armidale to test the feasibility of measuring vehicle speeds through school speed zones, and to develop an effective methodology for measuring the effectiveness of signage. In April 1994, the study was extended to 24 sites in Northern New South Wales, eight each in the Lower Hunter metropolitan areas, the Tamworth region, and the Coffs Harbour region. The studies included sites in both urban and rural situations. They resulted in a report to the Roads and Traffic Authority (Cunningham and Witherby, 1994) published in Witherby (1996). This work found that although approximately 50% of the zones studied

produced a statistically significant reduction in vehicle speeds, and that reduction was greater than 10 kilometres per hour in about 25% of cases, in only one case did the signs lead to compliance with the legal speed limit by at least 50% of vehicles. This earlier work failed to find any relationship between site characteristics and the performance of the sites. A range of environmental factors was studied including traffic volumes, road configuration and width, presence or absence of curb and gutter, grade, landuse, presence of parking and number of lanes.

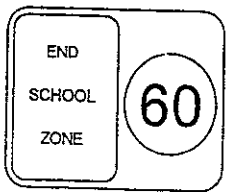
The present study, conducted between March and September 1996, represents a follow-up of that original research. Twelve of the original sites were re-examined, and an additional twelve sites in the Sydney metropolitan area were studied. In all cases, the sites under study controlled speeds within the zone by way of signage alone. It was one of the objectives of the research to ascertain if signage was sufficient in itself to control vehicle speeds through school zones. If this were the case, it would represent a very effective investment in traffic safety around schools. The Sydney sites varied in their signage from the non-metropolitan sites, in that they were supported by road patches in yellow showing a cross-hatched "40" and by yellow highlighting on the signs themselves Since November 1996 this style of signage has been current practice for all new sites in New South Wales, but non-metropolitan sites had not been changed to this new signage within the period of the study. Figure 1 illustrates the original and enhanced signage.

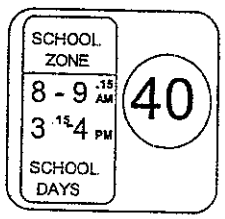
Figure 1 - Typical Signage

Enhanced signage



Original signage





Methodology

The 24 sites in the original study were selected to provide a reasonable cross section of typical sites in urban and rural areas. Because of the different nature of morning and evening traffic, morning and evening cases were considered separately. Each site thus yielded two case studies. Sites were classified by the following characteristics:

- Whether they were on a local road (L), a collector road (C) or a highway (H)
- Whether traffic speed through the zone was constrained (C) or unconstrained (U) by the nature of the road alignment outside the zone. A constrained site was one where vehicle speeds entering the zone would normally be low because of a characteristic in the road alignment, such as a roundabout or a sharp curve, which automatically

brought the entry speed to well below the posted speed limit. On the other hand, the alignment of an unconstrained site was such that, without the artificial constraints imposed by traffic density or the lower school speed limit, it was possible, if not legal, for vehicles to proceed through the zone at or above the general urban speed limit of 60 kilometres per hour.

- Whether the site was urban (U) or rural (R) in character.

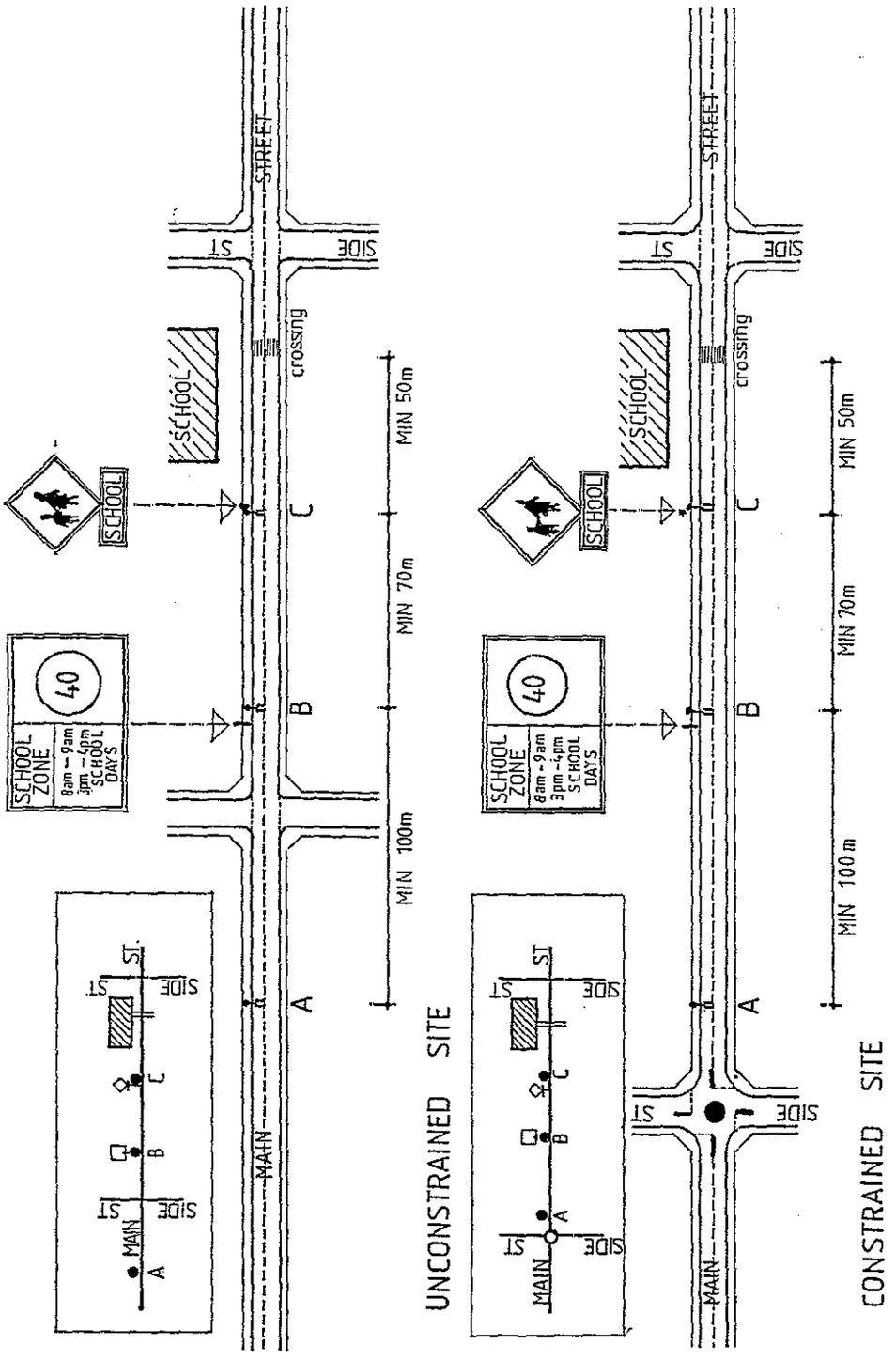
Twelve new sites in the Sydney metropolitan area, six constrained and six unconstrained, with various mixtures of local and through traffic, were added to the twelve country sites selected from the 1994 study. All sites had a pedestrian facility, and a government primary school on one side of the road, as well as low to moderate grades. There were therefore twenty-four sites for the new study. These were studied in the morning and evening periods of school speed zone operation, giving a total of 48 case studies

The equipment used to measure vehicle speeds was the Microcom TCS3000 counter classifier utilising switches. The units record comprehensive information about vehicle flows and types allowing calculation of speed, headway of vehicles and type of vehicle by any one of three classification categories. AUSTROADS classifications were used in this case. Equipment setup and field practices followed the procedures established in the 1994 study (Cunningham and Witherby, 1994).

Data collection involved tracking vehicles through three stations at each site. Figure 2 gives an indication of the standard layout for data collection at each site. Data were collected for both the morning and afternoon periods ensuring where possible that data collection included a period of one hour both before and after the period of the signs operation. This allowed comparison of vehicle speeds during periods of operation and during adjacent periods (see Appendix, Tables A, B and C).

As in the 1994 study, raw vehicle data was processed to ensure that only free vehicle speeds were used in the comparisons. This was to reduce the impacts of queuing and interruption of traffic flow through use of the pedestrian crossings and the like on vehicle speeds. Processing of the data involved a number of stages. Output data from the Microcom units was converted using a custom conversion program to a form suitable for reading by the program *Buffer* produced by ARRB Transport Research Pty Ltd. The *Buffer* program allowed lost vehicles, slow vehicles, and vehicles with headways below 4 seconds to be excluded from analysis. This ensured that the same cohort of vehicles was being considered at each station through the site. The output from the buffer program was then uploaded to the Minitab program where the Mood test was utilised to determine statistically significant differences between periods when signs were operating and periods when they were not. Data collection achieved a reasonable level of reliability with complete data sets available for twenty-two out of the twenty-four sites. Partial data is available only for Mount Hutton p.m. with one recorder failing. Difficulties were also experienced at Croydon Park in both a.m. and p.m. periods with one data recorder failing. Nevertheless, partial analysis could still be undertaken for these sites

Figure 2 - Site Layout Principles



In addition to the vehicle data described in the preceding section, household interviews were undertaken within one kilometre of all studied sites, using a systematic random sampling procedure. Thirty households were selected for each non-metropolitan site and twenty for each metropolitan site. As far as practicable, each person holding a driver's licence in each household was separately interviewed. Two different instruments were used, one for non-metropolitan and one for metropolitan sites. The metropolitan instrument was revised following experience with the non-metropolitan instrument. Notwithstanding the slight differences between the two instruments, the majority of questions are comparable across the whole study.

The survey instruments were developed in consultation with Dr Don Martin of the University of New England Department of Psychology and with the NSW Roads and Traffic Authority Road Safety and Traffic Management Directorate. The interview protocols were reviewed by the University of New England Ethics Committee, which permitted the study to proceed on the basis of those protocols. Besides routine data on household income, employment, and numbers of drivers, respondents were asked about their awareness of school speed zones and the speed limits set therein; whether they personally comply with that limit; whether they think other motorists comply with the limit; their thoughts on speeds in residential areas; and their attitudes towards policing of school speed zones, including the possibility of community policing.

Results

The results of speed observations are shown in Table C in the appendix. In 47 cases, median speeds of traffic through the zones in times within and outside sign operation could be measured. The following results emerged:

- In no case did the signs have the effect of reducing speeds of traffic so that 85% of drivers complied with the posted speed limit. In terms of the original definition, nowhere were the signs *highly effective*.
- In four metropolitan cases (Lindfield morning, Roseville morning, Killara morning, and Strathfield morning) signs were significant in the achievement of a median traffic speed below the posted limit. However, the evening data from the same sites showed no significant effects from the signs, notwithstanding recording of median speeds only just above, and in one case (Killara evening) below the posted limit. Actual speeds in the evening were very little different from the morning speeds. It is likely, therefore, that in these morning cases, while the signs are *moderately effective* under the definition, they are in fact only slightly reinforcing the effect of speed reductions brought about by prevailing traffic conditions and road alignment design.
- In the case of country sites, there were none where the signs were significant in reducing median speeds below the posted 40 km/h limit. One site (Hillvue at Tamworth) came close, almost replicating the performance of that site in the original studies. Even where signage was shown to affect traffic speeds in the non-metropolitan sites, it was only *slightly effective*.
- Overall, the signs achieved some reduction in the usual median speed of traffic in only 22 out of 48 cases. This was 14 km/h at the Tamworth Hillvue site, bringing median speed down to just above the posted limit in both morning and evening

periods of sign operation. Other country sites posted reductions between 6 km/h and 10 km/h in those cases where signs could be demonstrated to have had an effect. Metropolitan signs, where effectiveness was demonstrated, achieved lower reductions, between 5 and 9 km/h, but speed of traffic in times when the signs were not operating was also lower in the metropolitan sites. Generally, however, signs were, at best, *slightly effective,* and even this occurred in less than 50% of all cases.

Was there any difference between attitudes of metropolitan and non-metropolitan drivers? A chisquare analysis indicated that there was no significant difference, at the 5% level of confidence, in number of significant sites; number of sites with sign-significant median speed reduction greater than 10 km/h; average sign-significant median speed reduction; or number of sites achieving compliance with posted speed limits. Driver behaviour in school speed zones appears, therefore, to be similar throughout the state.

As in the original study, significance was assessed against whether the volume of traffic was low, medium or high; whether traffic was predominantly through, local or mixed, and whether the sites were constrained in entry speed or not. No clear patterns were found with respect to non-metropolitan sites. Several items of interest were, however, revealed in Sydney sites. In particular, the effect of signs was more significant in the morning period. In all but one case, this coincided with that period having the highest traffic volume, although actual volumes varied considerably from less than 100 vph to over 500 vph. As both the very high volume sites were significant, it is possible that, at volumes over 500 vph, traffic conditions provide some, if not most, of the constraint. Compliance appears, however, to be related to some particular characteristic of morning peak-hour traffic as compared with afternoon traffic.

The information from traffic observation was compared with that received from household surveys. Clearly, since the populations from the two surveys could not be methodologically linked, such comparison could not be direct or definitive. Nevertheless, it is a reasonable speculation, given the size of the two samples, that drivers in the household surveys were reasonably representative of those using roads around school zones. Drivers in 543 households were interviewed. Of these households, 344 were within one kilometre of non-metropolitan sites and 199 within one kilometre of the metropolitan sites where traffic speeds and behaviour were measured. In general the characteristics of the sample with respect to income, age, sex, number of drivers in the household, and employment reasonably match the NSW profile from the 1991 census, though, in respect of both age and income, the young, old, poor and wealthy are under-represented in the sample.

Metropolitan respondents were asked the extent to which they complied with speed limits on rural roads with the state maximum speed limit. Their response (see Table 1, over) showed that the majority break the speed limit at least some of the time.

Table 1 Metropolitan respondents own reported compliance with open road speed limits (source: 1996 September survey)

Comply with speed limit - open road	% Metropolitan Respondents (n=220)
Never	5
Rarely	2
Some of the time	15
Most of the time	40
All of the time	42

A similar question about urban speed limits evinced a similar response, shown in Table 2 below. On the basis of their own reporting, drivers apparently have similar attitudes to speed limits whether these limits are imposed in urban or rural areas.

Table 2 Metropolitan respondents own reported compliance with urban speed limits (source: 1996 September survey)

Comply with speed limit - urban areas	% Metropolitan espondents (n=221)
Never	1
Rarely	1
Some of the time	6
Most of the time	47
All of the time	45

All respondents, metropolitan and non-metropolitan, were questioned about the speed they would *prefer* to see for residential areas not on a main road. It should be noted that the questionnaires were administered just prior to the release of media information about the prospective 50 km/h speed limits. Retention of the general 60 km/h limit was supported by 53%, followed by 23% support for a 50 km/h limit and 16% for a 40 km/h limit, while only 2% would support a higher, 70 km/h, limit. There was very little response for limits in increments of 5 km/h (45, 55 or 65). While most favoured the status quo, there was considerable support (43%) for a general urban speed limit at or below 50 km/h. There is thus a curious 'cognitive dissonance' (see Festinger 1947), between what respondents believe is appropriate and their own reported behaviour concerning speed limits. This is discussed further below

The next series of questions related to areas around schools. In response to a question as to whether schools should be treated differently to other residential areas, 97% of respondents said that they should. This indicates overwhelming community support for the general concept of special zones around schools. Respondents also felt that the area around schools should be treated differently from other urban areas. When asked to nominate appropriate school zone limits 70% chose 40 km/h, though a further 20% chose a lower limit. Only 10% thought the existing limit was too restrictive. Respondents, however, perceive children's safety to be predominantly a schools-related issue. This ignores the reality that children pervade residential areas and, within or after school times, may be found throughout residential areas undertaking a wide variety of activities (Cunningham, Jones and Barlow 1996).

Almost all respondents (97%) were aware of the actual speed limits in their local school speed zones, but significantly fewer were aware of the precise times the restrictions were in force. Many were under the impression that the signs operated for a wider span of time than that actually posted. When asked whether the 40 km/h limit around schools should be full time or operate at selective times only, 35% of respondents supported a full time zone while 65% felt that selective time zones should be retained. Most support is for before school/arrival times and after school/leaving times as currently implemented, demonstrating the marked inclination for the *status quo* also shown in responses to other questions about speed. Some 20% of respondents, however, appeared to favour all day operation (daylight hours) on school days.

It was also clear that, for most respondents, school zones represented areas that called for special treatment with respect to traffic safety. Respondents who felt that areas around schools should not be treated differently had two different, and to some extent opposed, lines of reasoning. Firstly, some stated that signs were ineffective. The second group felt that the responsibility should come back to the child having been properly trained in road safety. This attitude is worrying given the evidence that children up to about age 13 are not capable of accurate judgements about vehicles (De Monchaux, 1981; Armstrong *et al* 1992). It is important, therefore, that public education stress that the primary responsibility for children's safety rests with drivers of vehicles and not with children or their parents. These responses also need to be considered within the context of the overwhelming support for areas around schools being treated as special. No respondents indicated that *all* residential areas should be treated in the same way as school zones.

All respondents, metropolitan and non-metropolitan, were very much aware of the existence of their local school zones (94%) and they claimed for the most part that they strictly observed the speed regulations (see Table 3). While there is no direct link between the surveyed populations and the behaviour of drivers of vehicles observed in school zones, these figures do suggest a very high degree of cognitive dissonance. There is no reason to suspect that people were being deliberately dishonest about their behaviour, indeed our interviewers reported considerable frankness

Table 3 Degree to which respondents report they comply with school zone (source: March 1996 survey and September 1996 survey)

Degree of Compliance with School Zone - Self	% All respondents (n=524)
Never	1
Rarely	1
Some of the time	2
Most of the time	20
All of the time	76

Responses to general observance of speed limits discussed above also suggest such frankness. Nevertheless, if these perceptions were accurate we could expect that signage of about three quarters of school speed zones would be highly effective in limiting about 85% of traffic to the posted limit. In fact, with the exception of a small

number of Sydney zones, virtually no sites were even moderately effective. This indicates a clear dissonance between people's public expressions of their behaviour and their actual behaviour.

Indeed, metropolitan responses to the question of when they complied with posted speed limits, indicated a very flexible attitude towards speeds within zones. The question was an open one, and 60% responded that they observed the signs 'when there were children about'. A further 11% said they complied when crossings were supervised or policed, and a significant 10% complied 'when they were not in a hurry'. Some 38% admitted speeding in school zones 'when there was nobody about', and no less than 29% of respondents said that they broke the speed limit 'when they were in a hurry'. These statements, of course, contradict what they said about their observance of school zone speed limits. This is a difficulty for the implementation of school speed zones, as there is the implication from the responses that when drivers perceive a control to be unnecessary or unreasonable they tend to disobey it. This is also supported by the observation evidence discussed above. These responses also indicated that unless drivers perceive a risk from speeding they are likely to disobey the school speed signs. When asked to comment on the behaviour of *other* drivers, a somewhat different picture emerges (see Table 4). The perceived pattern of behaviour is somewhat more realistic, but is still a long way from matching the observed performance of the zones. If this pattern were a reflection of reality, then signage in a majority of zones would be at least moderately effective.

Table 4 Degree of compliance with school speed zones - perception of behaviour of other drivers: metropolitan respondents (source: September 1996 survey)

Degree of compliance by other drivers	% Metropolitan respondents (n=209)
Never	1
Rarely	12
Some of the time	46
Most of the time	38
All of the time	2

When asked what speed *other* drivers travelled through school speed zones, respondents gave a pattern of answers more consistent with the observed data (see Table 5).

Table 5 Estimated speed of other drivers when zone is operating: metropolitan respondents (source: September 1996 survey)

Estimated average speed by other drivers (km/h)	% Metropolitan respondents (n=206)
30-40	18
40-50	51
50-60	25
60-70	6

The dissonance between these given figures and respondent perceptions of compliance is quite striking. Respondents were fully aware of the penalties that they could incur if

they were caught speeding in school speed zones. City drivers were slightly more aware than country drivers of the current difficulty that police have in securing such convictions, but even so 83% said that police can book offenders, as against 99% in country areas. What is also significant is that 98% of all respondents said that police *should* book offenders. However, the reason they advanced for this imperative is not so much the increase in safety involved through enforcement, but rather that 'police should enforce the law'. Speeding, it appears, is regarded as a kind of game, the primary rule of which is 'thou shalt not get caught'. There do not seem to be ethical or moral connotations. When asked about community policing, where community members could report offences which would lead to the offender being cautioned, but not convicted, by police, 54% of respondents agreed with the idea and 46% dissented.

Conclusions

School speed zones, as currently implemented in New South Wales, are not even moderately effective in changing the behaviour of drivers. None of the findings of this study bode well for the use of signage as the primary means of inducing safer behaviour on the part of drivers in respect of school zones. This is also likely to apply to the general neighbourhood, where the presence of children or vulnerable pedestrians dictates the need for slower traffic speeds. Furthermore, it appears that the problem does not lie predominantly in the actual design of the signs themselves. Metropolitan sites with their more visible signs and road markings proved to be no more effective than the rural areas with the older style signs. The real difficulty seems to be driver attitude towards observance of speed limits.

It thus seems that driver psychology is a major obstacle to effective compliance, and this extends well beyond school zones to consideration of holistic issues of urban and neighbourhood design. Traffic, and especially speeding traffic, not only reduces safety for pedestrians and other road users, especially children, but also inhibits legitimate, non-traffic-related uses of urban streets for recreation, social activity, and access to property and facilities (Appleyard, 1970; Engwicht 1992, 115-140). While drivers perceive themselves as the most important, or even the only legitimate users of roadspace, it is unlikely that the 'cognitive dissonance' so strikingly revealed by this study will disappear. Driver training and community education must therefore address this difficult issue.

The survey data also showed that people have a marked tendency to accept the status-quo as far as speed limits are concerned. They felt that the general urban speed limit should remain at 60 kilometres per hour, but were happy to see school speed zone speeds at 40 kilometres per hour. In New South Wales, speed limits are set at multiples of 10 kilometres per hour and there was a noticeable tendency for respondents to prefer this. We have no data from other states or countries, where limits may be set in multiples of 5 kilometres per hour, but we suspect that whatever the system is, that is what people accept. We therefore believe that the public as a whole would accept new and lower speed limits in urban areas, given a reasonable period of adjustment. Certainly there was almost unanimous support for rigorous policing of speed limits

within school speed zones. Speed limits might be seen as a game, but our respondents were happy to play by the rules of the game, and even accept changes to the rules which made it harder for them to transgress.

Irrespective of area, the respondents' perception of safety for children appeared to be linked solely to schools without any appreciation of the presence of children elsewhere within the urban environment. There is limited awareness of the benefits of speed reduction, and, in particular the impact of a reduction of 10 km/h., in the general urban speed limit. This is noted, however, within the context of fairly strong support for lower urban speed limits generally. Support for lower speed limits, particularly in metropolitan areas, may simply be a reflection of the traffic environment rather than a concern for safer neighbourhoods for children and vulnerable pedestrians.

Recommendations

While the primary purpose of the study was to find out if school speed zones were working effectively, the disappointing results on compliance certainly foreshadow a need for action. The issue of cognitive dissonance suggests that any long term solution can only come through substantial behavioural modification as a result of a concerted education strategy. Already some parts of this sort of strategy are in place. Radio advertisements prompting drivers to think about "*How fast are you going now*" and that "*Drink-driving isn't bad luck, it's a crime*" are aimed at inducing ethical or moral perceptions of driver behaviour. But are we tackling this issue right along the chain? We suspect there is a need to look right back to driver training and testing. Indeed, given that most people seem to view driving as a right not a privilege, perhaps we need systematic processes to formally review drivers. In addition to dealing with driver training and testing there is a need for a comprehensive education campaign to target the attitudes and behaviours exposed in this study. Predominantly these are driver's priorities where personal convenience rates ahead of the safety of others. Compliance with laws is perceived as a matter of choice. There is also the need to address areas of poor knowledge. The benefits of speed reduction on safety in urban areas need to be stressed, as does the fact that children on the streets, and indeed their right to be there, is not just a problem around schools. Such a strategy will probably require a generational change before it has a major impact. In the short run there are other actions which, although not likely to produce radical change, may result in a significant, though modest improvement.

1. A study site could be refitted with flashing lights to indicate when the sign is operating. Before and after studies could be carried out at such a site to test the effectiveness or otherwise of this more visible signage.
2. Responsible authorities could review signage location for existing speed zones paying particular attention to sign visibility. This should include lopping of vegetation which obscures signs. Older signs should be progressively replaced with new signs and road markings.
3. Consideration could be given to area wide treatments as these have been demonstrated in the literature to be more consistent than single street limits in reducing speeds, albeit with smaller overall reductions. It is noted that this

recommendation is in agreement with the recently announced policy to implement school speed zoning on all streets adjacent to school sites

4. Given that a small majority of respondents supported the idea, consideration could be given to a trial of community policing or other socially acceptable ways of applying peer pressure to reduce anti-social driver behaviour. Such experiments would have to be undertaken with exceptional care to detail, however, recognising the potential for infringement of perceived individual rights.

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Disclaimer

The views expressed in this paper are the views of the authors and do not necessarily represent the views of the Roads and Traffic Authority of NSW.

References

Appleyard, D (1981) *Livable Streets*. Berkeley: University of California Press

Armstrong, H B Black, J A Lukovich, I Sheffield, D and Westerman, H L (1992) *Environmental Adaptation of the Main Street in Country Towns: Towards Guidelines*. Canberra ; Federal Office of Road Safety.

Cunningham, C.J., Jones, M A. and Barlow. 1996. *Town Planning and Children: a case Study of Lismore NSW, Australia*. Armidale: University of New England, Department of Geography and Planning

Cunningham, C.J. and Witherby A.W. 1994. 'School speed zones, utility or fantasy'. Report to the NSW Roads and Traffic Authority. Armidale: University of New England, Department of Geography and Planning

De Monchaux, S. 1981. *Planning with Children in Mind*. Sydney: Department of Environment and Planning and the Land Commission of New South Wales

Engwicht, D. 1992. *Towards an Eco-City: Calming the Traffic*. Sydney: Envirobook

Festinger, L. 1947. *A Theory of Cognitive Dissonance* Evanston: Ross, Peterson

Witherby, A.W 1996 *Vehicle speed and child safety. The split personality of the driver* Road and Transport Research, Vol.5 No.3 September 1996. Hawthorn: ARRB Transport Research

Appendix

Table A List of Sites - April 1994 study

North Coast	Type (see below for key)	Significant in previous study?	Did site achieve Median speed reduction >10 km/h?	Traffic type (see below for key)	Volume	Time of worst perform-ance	Comments	In 1996 study?
Coffs Harbour	CUU	am and pm		T	H		Vol high, multi lane	No
St Augustine	CCU	am	No	T	MH	pm	Not public	No
Narang	LCU	am	Yes	M	M		OK	Yes
Boambee	CUR	am	No	L	M	pm	OK	Yes
Sawtell	LUU	No	No	L	L	am	OK	Yes
Urunga	LCR	No	No	L	M	Both	OK	Yes
Sth Grafton	CUR	am	No	M	MH	pm	OK	No
Ulmarra	HUR	am and pm	No	T	MH		Hwy	No
Inland								
Murrurundi	HUR	No	No	T	M	Both	Hwy	No
Currabubula	HUR	am	Yes	T	M	pm	Hwy	No
Tamworth	CUU	am and pm	No	M	M		OK	Yes
Boolimbal	LCU	No		L	L		Special school	No
Hillvue	CUU	am and pm	Yes	M	M		OK	Yes
Tamworth S	LCU	am	No	L	M	pm	OK	Yes
Bendemeer	LCR	No	No	L	L	pm	Low vol	No
Kootingal	LUR	am	Yes	L	M		OK	Yes
Hunter								
Biddebah	CCU	am and pm	Yes	M	H		High Vol	Yes
Warner's Bay	CUU	pm	No	T	H	am	High School	No
Tenambit	LUU	am	No	M	M	pm	OK	Yes
Rutherford E	LCU	No	No	L	L		Low Vol	No
Rutherford W	LCU	pm	No	L	M	pm	OK	Yes
Metford	LCU	No	No	L	L		Low Vol	No
Shortland	CCU	No	No	T	H	Both	High Vol	No
Mt Hutton	CUU	No	No	T	MH	Both	OK	Yes

Key: Type: 1st letter = road type **H**ighway, **C**ollector, **L**ocal
2nd letter = **C**onstrained or **U**nconstrained
3rd letter = **U**rban or **R**ural

Traffic: T=mainly through traffic
M=mixed
L=mainly local traffic

Table B - Additional Sites from Sydney Area: September 1996 survey

Sydney	Constrained/ Unconstrained	Type of Traffic	Traffic Volumes High=>800vph Med=3-800 vph Low = <300vph	Significant AM?	Significant PM?
Inner/ Middle West					
Strathfield	Unconstrained	Local	Low	Yes	No
Campsie	Unconstrained	Local	Medium	No	No
Croydon Pk	Constrained	Local	Low	No	No
Mt Lewis	Constrained	Through	Medium	No	No
North Shore					
Roseville	Unconstrained	Local	Low	Yes	No
Lindfield	Constrained	Through	Medium	Yes	No
Turramurra	Unconstrained	Through	High	Yes	No
Killara	Constrained	Local	Low	Yes	No
Middle/ Outer West					
Dulwich Hill	Constrained	Mixed	Low	No	No
Villawood	Constrained	Mixed	Medium	Yes	No
Fairfield Hts	Unconstrained	Local	Low	Yes	Yes
Sefton	Unconstrained	Through	High	Yes	No

Table C1 Observed speeds and summary information: non-metropolitan sites, March 1996 study

Site	Time	Actual Reduction (km/h) (a)	Median with sign operating (b)	Significant? (c)	Total reduction required for compliance (=a+b-40)
Coffs Harbour					
Boambee	am	9 (9)	47	Yes*	16
	pm	7 (4)	51	Yes	18
Narang	am	4 (13)	43	No*	7
	pm	0 (6)	41	No	1
Sawtell	am	0 (0)	45	No	5
	pm	7 (15)	41	No	8
Urunga	am	-1 (4)	38	No	Nil
	pm	5 (4)	38	No	Nil
Newcastle					
Biddebah	am	8 (10)	48	Yes*	16
	pm	9 (5)	48	Yes*	17
Mt Hutton	am	5 (3)	51	No	16
	pm	No data (1)			
Rutherford	am	10 (6)	48	Yes*	18
	pm	11 (6)	48	Yes*	19
Tenambit	am	1 (6)	45	No*	6
	pm	6 (3)	46	Yes	12
Tamworth					
Hillvue	am	14 (16)	41	Yes*	15
	pm	14 (17)	45	Yes*	19
Kootingal	am	8 (11)	48	Yes*	16
	pm	3 (10)	55	No*	18
Tamworth P	am	8 (8)	42	Yes*	10
	pm	0 (9)	48	No*	8
Tamworth S	am	9 (7)	45	Yes*	14
	pm	9 (3)	45	Yes	14

Notes

(a) This is the measured reduction of median speed in the time of operation of the sign compared with the times when the sign was not operating. The figure in brackets indicates the median speed reduction in the April 1994 study.

(b) This is the median speed of traffic recorded in times of operation of the sign

(c) This indicates whether there was actually any significant effect of the sign in achieving the observed reduction. The asterisk indicates sites where the sign was significant in the April 1994 study.

Table C2 Observed speeds and summary information: Sydney sites: September 1996 study

Site	Time	Actual Reduction (km/h) (a)	Median with sign operating (b)	Significant (c)	Total reduction required for compliance (=a+b-40)
Sydney					
Fairfield	am	6	48	Yes	14
	pm	6	50	Yes	16
Lindfield	am	9	37	Yes	6
	pm	3	42	No	5
Mt Lewis	am	3	52	No	15
	pm	3	50	No	13
Roseville	am	9	39	Yes	8
	pm	3	43	No	6
Sefton	am	7	55	Yes	21
	pm	1	60	No	21
Campsie	am	2	47	No	9
	pm	4	43	No	7
Croydon	am	5	35	No	40
	pm*	0	36	No	Nil
Dulwich Hill	am	0	41	No	1
	pm	1	41	No	2
Killara	am	7	32	Yes	Nil
	pm	3	35	No	Nil
Turramurra	am	8	44	Yes	12
	pm	6	47	No	13
Strathfield	am	7	38	Yes	5
	pm	1	42	No	3
Villawood	am	5	52	Yes	17
	pm	1	58	No	19

Notes

(a) This is the measured reduction of median speed in the time of operation of the sign compared with the times when the sign was not operating.

(b) This is the median speed of traffic recorded in times of operation of the sign.

(c) This indicates whether there was actually any significant effect of the sign in achieving the observed reduction.