

# HOW PLAYERS LISTEN

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The games industry currently lacks detailed understanding of the audio configurations which their listeners use to play games. Codemasters surveyed players to investigate the listening systems and configurations they had available, and those they preferred. The results of this survey have implications for the way audio assets are prepared, rendered and mixed in games. Future consumer research is proposed in light of new platforms and audio interfaces.

## INTRODUCTION

This paper explains the equipment consumers use to listen to games on PCs and game consoles, and highlights the differences. When new game consoles were announced in 2005 Codemasters collated the listening preferences and the upgrade plans of more than 700 customers, following a survey.

While there is clearly no one ‘right answer’ to suit every set-up, it is possible to identify differences between the expectations of PC and console users and plan accordingly. The dynamic rendering and configuration inherent in interactive game systems make it practical to design user options and cross-platform game systems so that mixes can be optimised for each popular configuration, rather than reduced to a lowest common denominator.

As every option in a game either increases the total amount of testing that needs to be performed, or decreases the amount of time that can be spent testing each mode, it is important to identify the most popular listening configurations on each platform as well as the choices potentially available to players.

Game consoles contain a limited and varying set of audio options built-in to the system. Additional options within the game, across platforms, can make these more consistent and relevant to the particular type of game.

Cross platform game development spreads the cost and risk of writing a game, but each version must still meet the capabilities of each platform if it is not to be eclipsed by single-platform titles. In a hit-driven business where a small proportion of releases generate the vast majority of revenue, games must adapt to platform capabilities and player preferences.

This survey has helped Codemasters tailor their audio technology to the benefit of our customers, and publication here benefits gamers in general and is also helpful to equipment manufacturers and middleware developers.

## 1. THE SURVEY

The invitation to participate in the survey was mailed out to registered members of Codemasters’ online community Code M [1] in May 2005. A wide spectrum of PC and Console users were consulted: 5,000 in each category. Customers from five markets - USA, UK, France Germany and Australia – were included so that regional patterns and differences could be identified.

A conference poster presentation is inevitably just an overview, so the full results of the survey in the form of spreadsheet pages as well as slides have been made freely available for download and further analysis. [2] This includes information about upgrade intentions and attitudinal statements as well as more detail on the questions listed here.

### 1.1 Available platforms

The first question we asked was what platforms were available to each player. Since the survey was distributed online it’s no surprise that nearly all respondents had access to a PC. The average number of platforms available to these gamers is 2.1, and the proportions of Sony, Microsoft and Nintendo users are consistent with the console installed base at the time, with Sony’s PS2 dominant followed by Microsoft’s Xbox and the Nintendo Gamecube.

Figure 1 shows the result of this survey question.

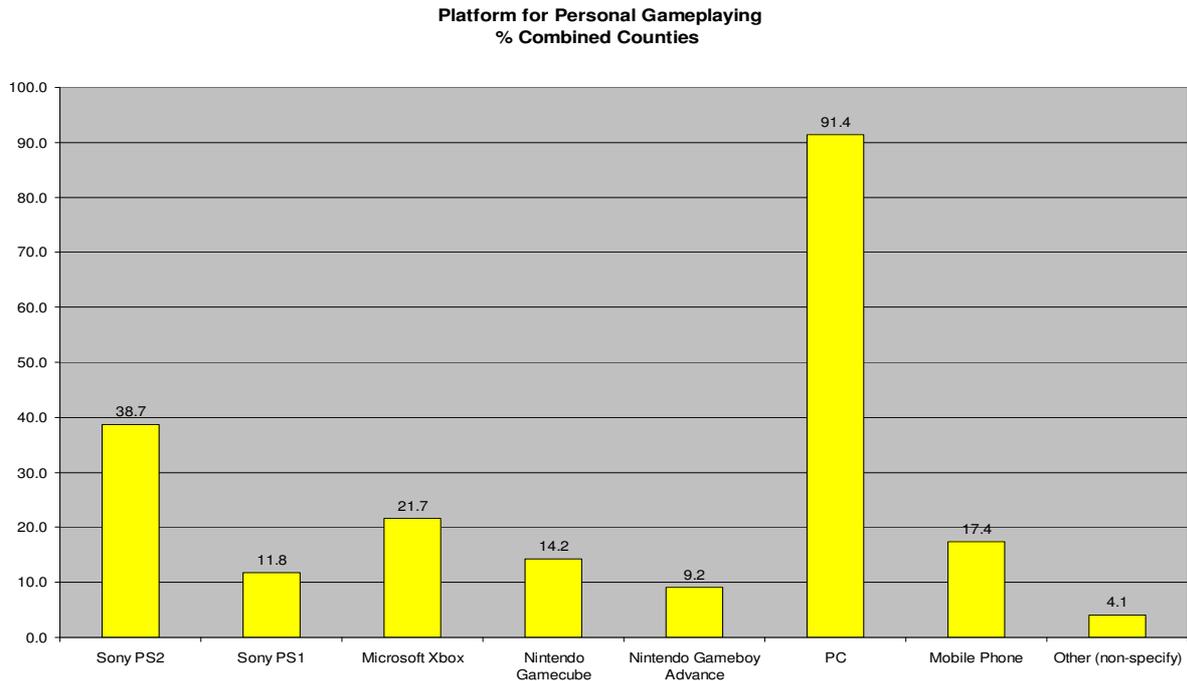


Figure 1

### 1.2 Hours played per week

We also asked the respondents how much time they spend playing each week. Two thirds of the sample played for six or more hours. Figure 2 shows this and the breakdown by territory. It implies that the USA has a much higher proportion of hardcore gamers, putting in long hours, than the other countries.

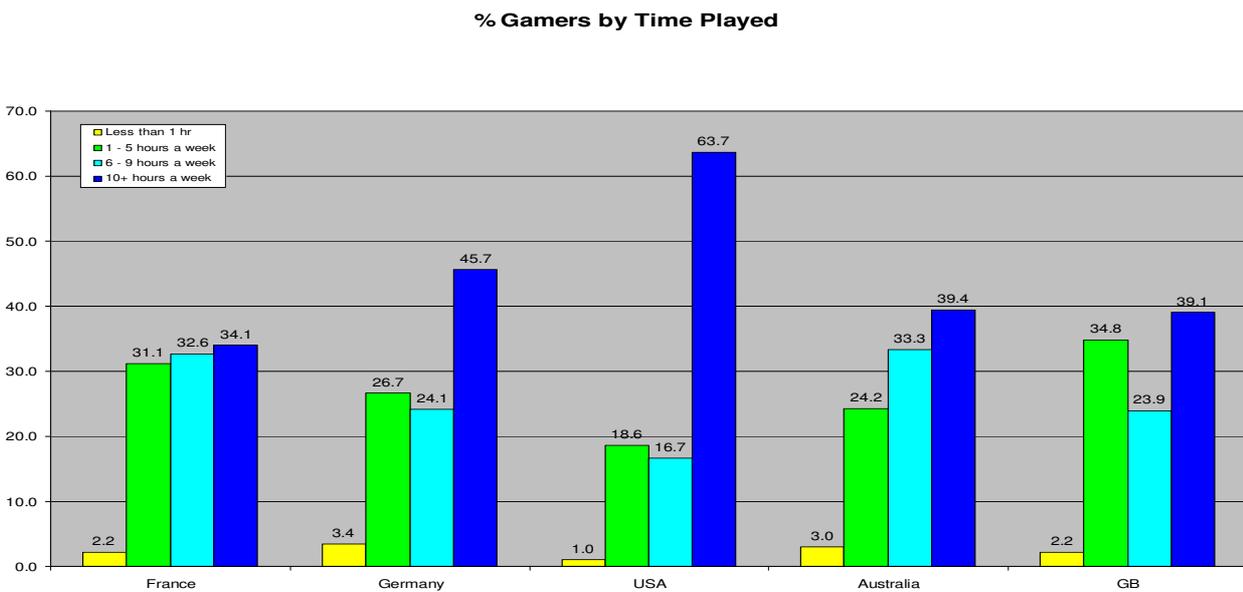


Figure 2

## 2. CONSOLE LISTENING

Half the console gamers surveyed normally listen via a stereo TV or stereo speakers. A further third usually listen to surround sound. Headphones and mono TV configurations are less common, but still comprise the remaining sixth, fairly evenly split. The use of mono TVs is significant because it means we cannot rely on stereo as a lowest common denominator, even though some consoles do not include a mono configuration option.

Figure 3 shows the response over all territories, while Figure 4 includes a national breakdown. The sample base is relatively small for UK and Germany, making the results less precise for those countries. Exact figures are in the spreadsheet [2].

It should be noted that this question asks not how players *could* listen, but how they normally **do**, since this is more useful information for game developers in choosing defaults and identifying customer preferences.

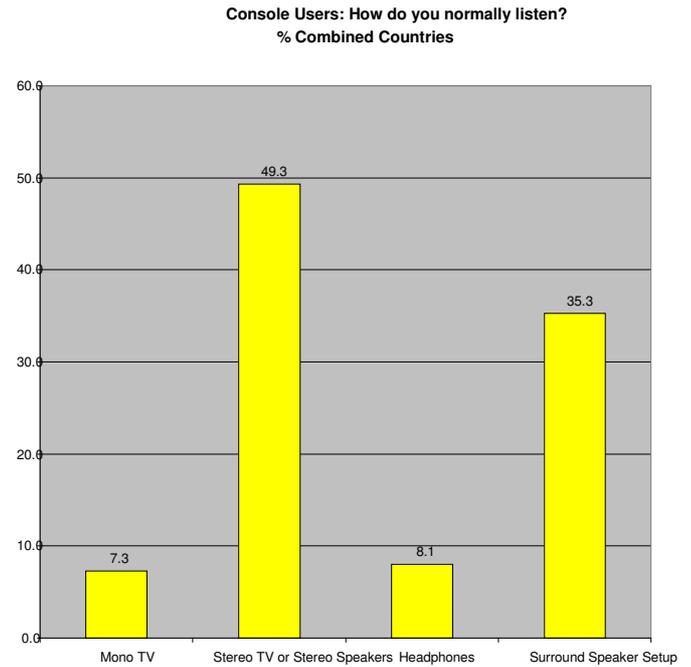


Figure 3

Console Users - How do you normally listen?  
NB: Small base in Germany and GB

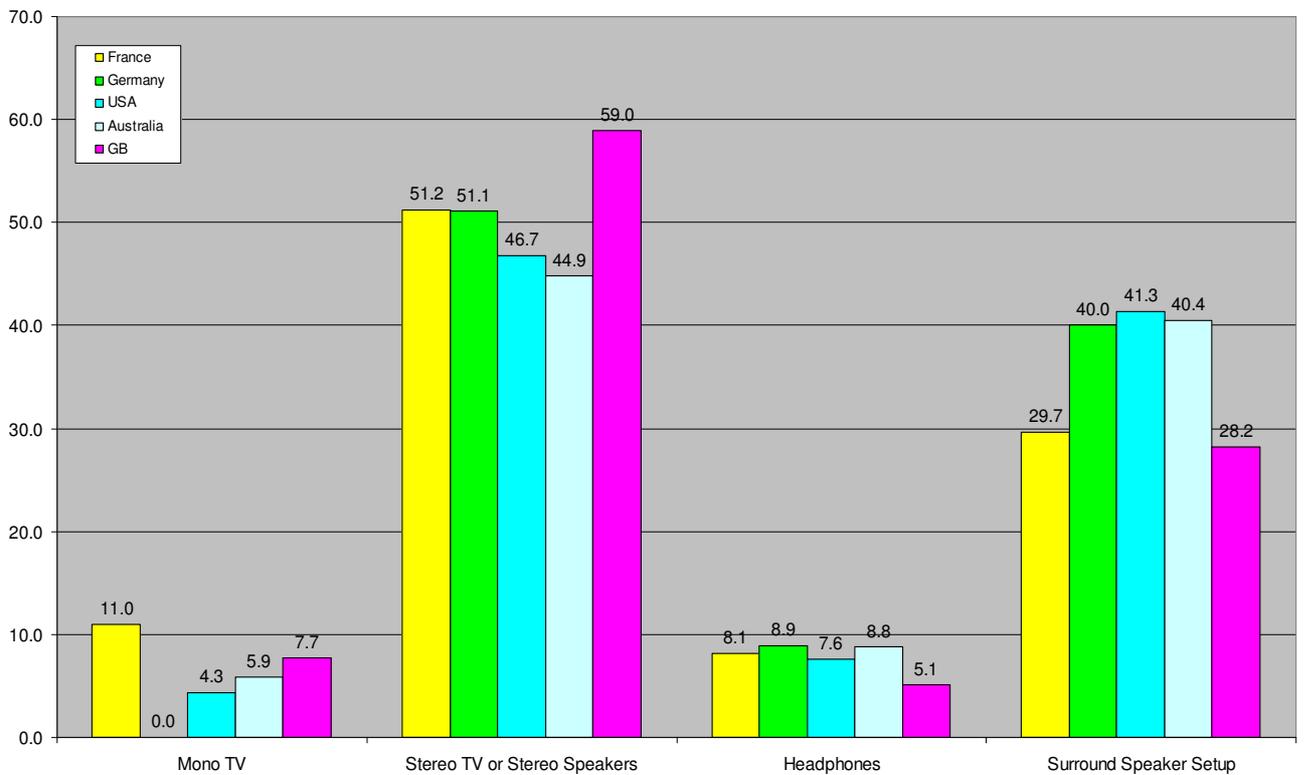


Figure 4

The survey also asked what audio formats respondents can potentially use. The question was “What audio formats could you listen to, if the game supported it? i.e. What formats does your TV or Hi-fi support? (tick all that apply).” Figure 5 shows a substantial installed base for Dolby Digital, slightly ahead of that for Dolby Pro Logic 2, with DTS trailing but still quite common. The chart shows percentages of overall response in each category. On average the 521 console-owning respondents selected 1.85 of the options each (965 choices), including 38 ‘don’t knows’.

This question was relevant as most home consoles (PS2, Xbox and Gamecube), supported real-time Dolby Pro Logic encoding at the time of the survey, but only Xbox implemented real-time encoding of Dolby Digital AC3 5.1 output. DTS encoding was available as an option on PS2, but was CPU intensive. In a follow-up question specifically for PS2 users we asked if DTS support in a game would encourage them to buy the game. 29 per cent agreed, with 28 per cent not sure and 43 per cent answering no. Respondents in Australia and the USA responded most positively and those in France and German least, though the subset nature of this question limited the size and significance of this result. Full details are in the raw data [2].

On PS2 Dolby Digital output was only supported for pre-encoded data (e.g. movies and pre-rendered cut scenes) and Nintendo offered only analogue output (as remains the case even on their current Wii console).

Real-time Dolby Digital encoding is now offered on both PS3 and Xbox360 and DTS is an option on PS3. PS3 also supports uncompressed LPCM in 5.1 and 7.1 channel formats over HDMI. Future surveys should track the take-up of HDMI surround, which was introduced after this survey.

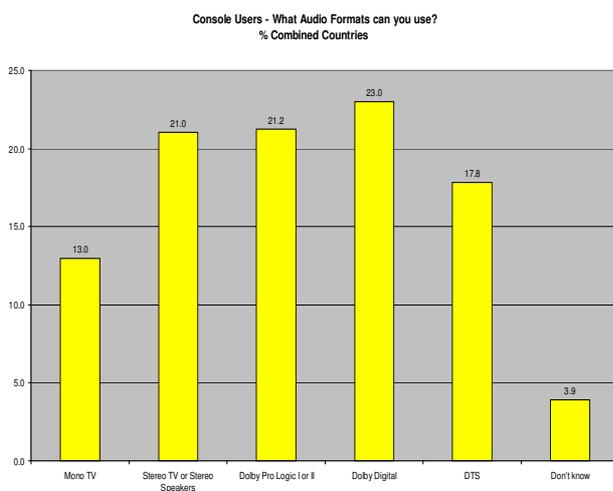


Figure 5

To measure the perceived importance of surround sound among console users they were asked to rate it on a five-point scale, from 1 (not at all important) to 5 (very important). Almost 40% of respondents considered surround sound ‘very important’, with nearly 70% rating it as ‘important’ and only 12% rating this aspect 1 or 2, as shown in Figure 6:

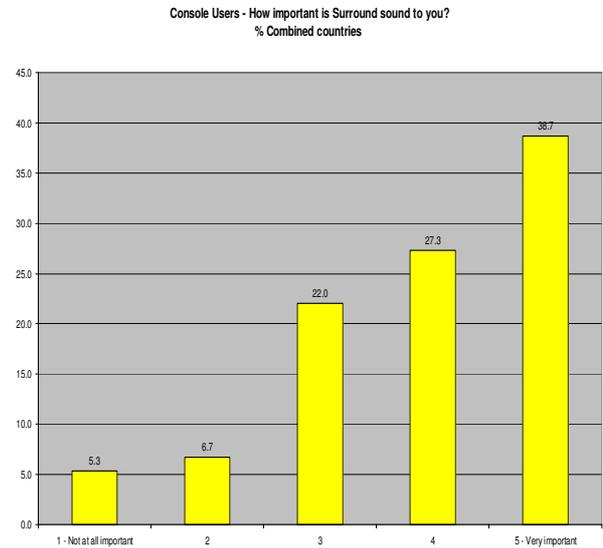


Figure 6

There were notable variations in this result by territory, summarised in Figure 7. Surround sound is considered of relatively high importance in Australia and the USA, over 40 per cent deeming it ‘very important’. This is less so in Germany and the UK, though still over 30 per cent of respondents there scored it the maximum 5:

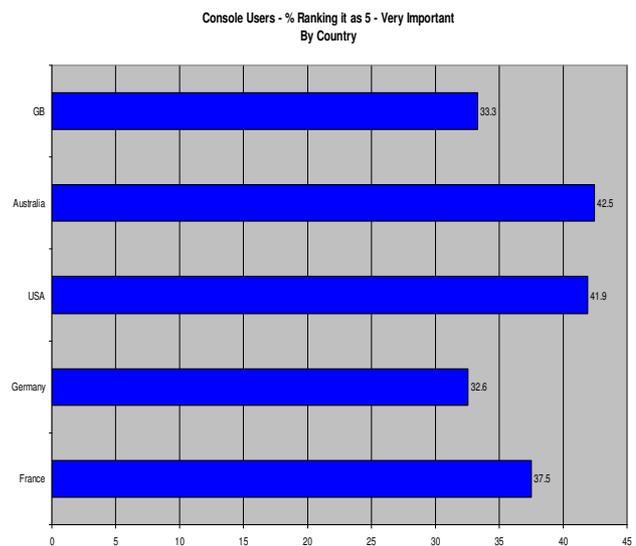


Figure 7

### 3. PC LISTENING

The preferences of PC gamers were intriguingly different from those of the console users. Figure 8 shows that headphone play is much more common. This implies that it's worth putting extra effort into techniques such as HRTF (encoding the front/rear and vertical position of sounds) for these customers.

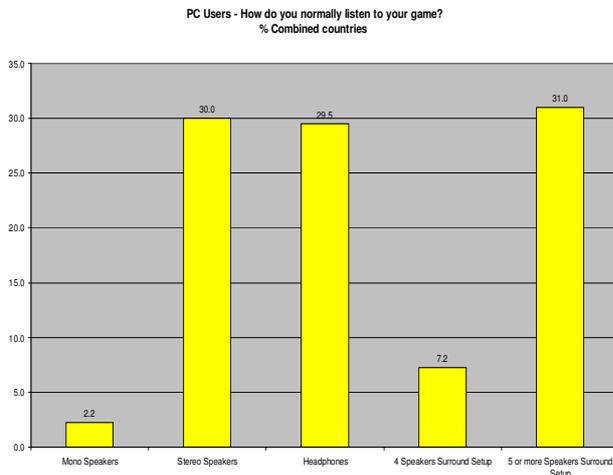


Figure 8

The survey shows that PC users are split virtually in thirds between stereo speakers, headphones and surround sound systems using five or more speakers. Mono was the preference of just 2.2% – it's perhaps surprising that even 14 of the 623 respondents normally listen that way – and the remaining 7.2 per cent (45 people) favoured four-speaker 'quad' setups. In retrospect, future surveys could usefully ask about 7.1 and larger setups.

We also asked PC users what sound card they had. Figure 9 shows motherboard audio (typically to the AC97 PC standard) was most often cited, but more than half of the respondents said they had one of three types of multichannel audio card: Nvidia's NForce range, Creative's SoundBlaster Live, which introduced six-channel 5.1 surround to tens of millions of PC owners, targeting gamers in particular, and the follow-up Audigy which has eight analogue output channels (7.1).

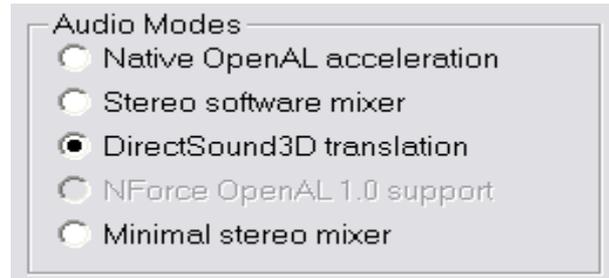


Figure 10

These Creative and Nvidia cards support hardware sample rate conversion, mixing and DSP which is faster than the default software mixers and typically of higher quality or capability (e.g. more effects). The Direct Sound 3D hardware drivers for these cards are not supported on Vista but they all have drivers for the alternative OpenAL API [3]. Figure 10 shows the configuration menu Codemasters implemented in Brian Lara Cricket 2007 [4], allowing players access to the most commonly-installed hardware DSP even on Vista. Lord of the Rings Online, Colin McRae DiRT and Race Driver GRID have benefited similarly from OpenAL.

What sound Card do you have? % Combined Countries

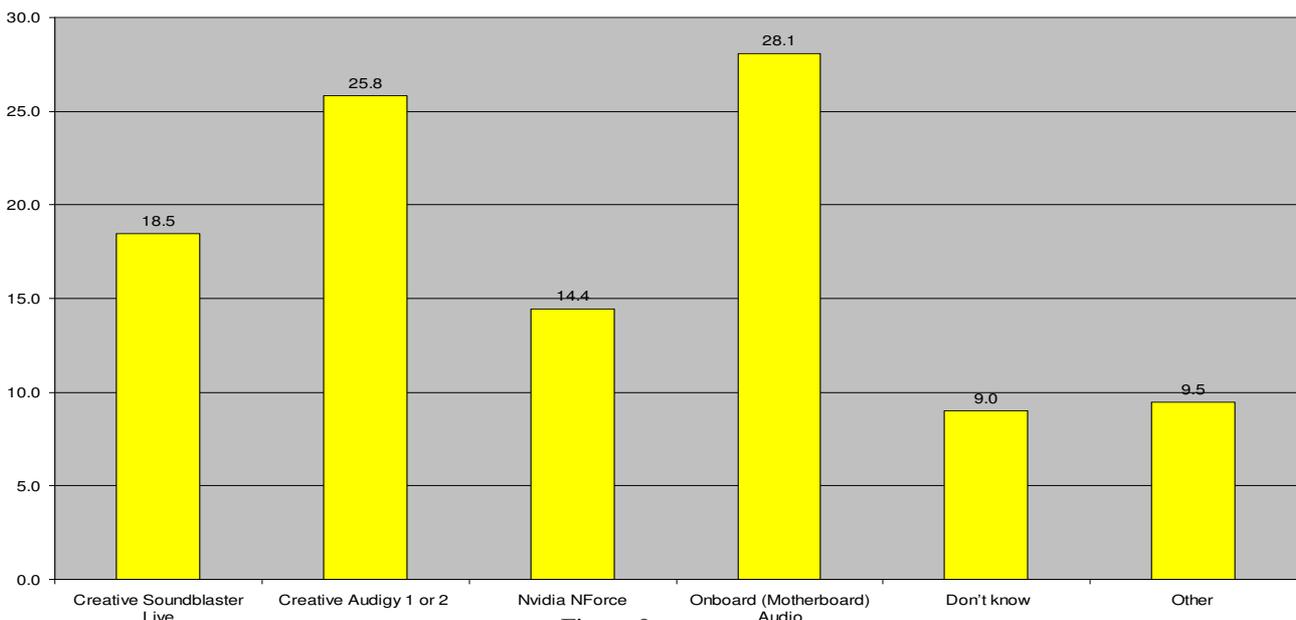


Figure 9

When PC users were asked how important they considered surround sound the response was not as strong as among console gamers, though a marginally smaller proportion (4.9 versus 5.3 per cent), reckoned it not at all important, as shown in Figure 11.

Overall 30 per cent of PC users rated surround as ‘very important’ but this figure was depressed by the results from customers in France, where no one rated it 5, unlike 36.6 to 40.5 per cent of those in other countries.

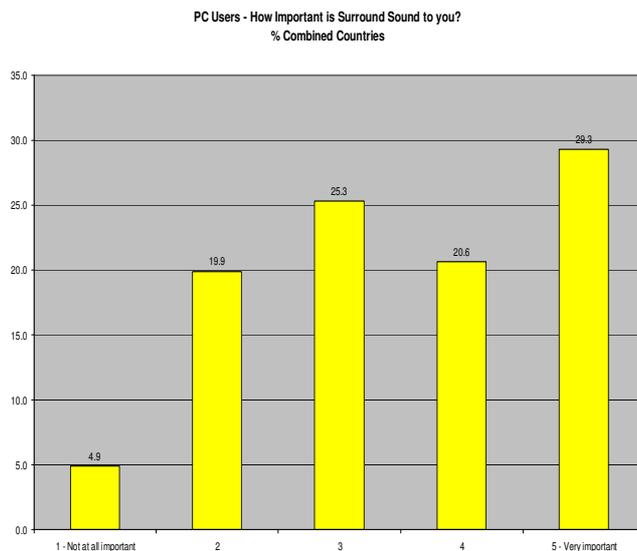


Figure 11

#### 4. TRENDS

Game audio hardware and software has continued to develop rapidly since the time of this survey. ‘Hi-def’ is about improved audio as well as video, and HDMI 1.3 has made eight channel uncompressed LPCM audio output a standard on the PS3 and on ‘graphics cards’ from the main PC vendors: Nvidia, ATI, and Intel. These cards now output audio as well as graphics.

Modern consoles and PCs have around ten times as much RAM as the previous generation, and this means more assets can be held in RAM with less compression and data streaming. New hardware changes the codecs preferred; PCM (for flexibility and granular synthesis) & psychoacoustically compressed formats (for variety) displace the ADPCM common on old consoles and PCs.

Vista and the prevalence of multicore processors mean it is now more likely that a general purpose processor will be used for audio, rather than the custom DSPs in previous generations of console and PC audio cards. On PS3 a SPU vector unit is typically dedicated to audio, whereas on Xbox360 a PowerPC hardware core is similarly employed. These, and the x86 processor cores

used by PC software mixers, are shared resources which need not be dedicated to audio purposes. There is thus more hardware available for audio now, and yet more competition for it from other parts of the game.

A future survey should ask about HDMI, 7.1 surround (and related speaker layouts). The paper “3D Sound for 3D Games – beyond 5.1” [5] at this conference explores some of the issues and implications of this development.

#### CONCLUSIONS

PC and game console owners differ in their expectations and experience of game audio. PC owners are more likely to play on headphones. Surround is perceived as important but most console players listen in stereo, at least at the time of the survey, and a significant minority in mono. Games cannot presume one listening environment but must adapt to that of the player, and the most appropriate choices and defaults depend upon the platform as well as the game genre.

The survey is anecdotal, since it addressed customers of just one publisher, and only some of those replied. New hardware has come out since. But in the words of Charles Babbage, “Errors using inadequate data are much less than those using no data at all.” [6] The survey was informative but not rigorous. A future survey should ask more people, contacted in different ways in case the online opt-in introduced bias. Platform vendors, developers, publishers and equipment manufacturers all have an interest in the results.

#### REFERENCES

- [1] Codemasters Club M online community, [http://www.codemasters.co.uk/code\\_m/joinup.php](http://www.codemasters.co.uk/code_m/joinup.php) (checked 2008-11-14)
- [2] The Audio Affect survey, May 2005, Powerpoint charts, questions and spreadsheet reply data, <http://www.codemasters.com/research/AudioSurvey.ppt> (checked 2008-11-18)
- [3] OpenAL open cross-platform 3D audio system, <http://www.openal.org> (checked 2008-9-1)
- [4] Brian Lara International Cricket 2007 game, [http://www.codemasters.co.uk/game\\_s/?gameid=2071](http://www.codemasters.co.uk/game_s/?gameid=2071) (checked 2008-11-18)
- [5] Goodwin, S. N., “3D Sound for 3D Games – beyond 5.1”, AES 35<sup>th</sup> Conference, 2009
- [6] Charles Babbage, “The Exposition of 1851” (London: Murray) pp. 25 (1851)